DEVELOPING A STATE WATER PLAN

GROUND-WATER CONDITIONS IN UTAH, SPRING OF 1973

by

E. L. Bolke and others

United States Geological Survey

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INTRODUCTION

This report is the tenth in a series of annual reports that describe ground-water conditions in Utah. Reports in the series are prepared cooperatively by the U.S. Geological Survey and the Utah Division of Water Resources and are designed to provide data for interested parties such as legislators, administrators, and planners to keep abreast of changing ground-water conditions.

This report, like the others (see references, p. 25), contains information on well construction, ground-water withdrawals, water-level changes, and related changes in precipitation and streamflow. Supplementary data such as graphs showing chemical quality of water and maps showing water-table configuration are included in reports of this series only for those years or areas for which applicable data are available and are important to a discussion of changing ground-water conditions.

The report includes individual discussions of the most important areas of ground-water withdrawal in the State for the calendar year 1972 and for the 10-year period 1963-72. Water-level fluctuations, however, are described for the periods spring 1972 to spring 1973 and spring 1963 to spring 1973. Many of the data used in this report were collected by the Geological Survey in cooperation with the Division of Water Rights, Utah Department of Natural Resources.

The following reports dealing with ground water in the State were released by the Geological Survey during 1972:

Ground-water conditions in the central Virgin River Basin, Utah, by R. M. Cordova, G. W. Sandberg, and Wilson McConkie, Utah Department of Natural Resources Technical Publication 40.

Ground-water conditions in Utah, spring of 1972, by C. T. Sumsion and others, Utah Division of Water Resources Cooperative Investigations Report 10.

Ground-water conditions in the East Shore area, Box Elder, Davis, and Weber Counties, Utah, 1960-69, by E. L. Bolke and K. M. Waddell, Utah Department of Natural Resources Technical Publication 35.

Hydrologic framework, by Ted Arnow, <u>in</u> Environmental geology of the Wasatch Front, 1971, Utah Geological Association Publication 1, p. C1-C7.

Hydrologic reconnaissance of the Blue Creek Valley area, Box Elder County, Utah, by E. L. Bolke and Don Price, Utah Department of Natural Resources Technical Publication 37.

Hydrologic reconnaissance of Pilot Valley, Utah and Nevada, by J. C. Stephens and J. W. Hood, Utah Department of Natural Resources Technical Publication 41.

Map showing general availability of ground water in the Salina quadrangle, Utah, by Donald Price, U.S. Geological Survey Miscellaneous Geological Investigations Map I-591-M, scale 1:250,000.

Map showing general chemical quality of ground water in the Salina quadrangle, Utah, by Donald Price, U.S. Geological Survey Miscellaneous Geologic Investigations Map I-591-K, scale 1:250,000.

Map showing springs in the Salina quadrangle, Utah, by H. R. Covington, U.S. Geological Survey Miscellaneous Geologic Investigations Map I-591-G, scale 1:250,000.

Water resources of part of Canyonlands National Park, southeastern Utah, by C. T. Sumsion and E. L. Bolke, U.S. Geological Survey open-file report.

UTAH'S GROUND-WATER RESERVOIRS

Small quantities of ground water can be obtained from wells throughout much of Utah, but large supplies that are of suitable chemical quality for irrigation, public supply, or industrial use, generally can be obtained only in specific areas. These areas of known or potential ground-water development are shown in figure 1 and named in table 1. Only a few wells outside of these areas yield large supplies of water of good chemical quality.

Less than 2 percent of the wells in Utah obtain water from consolidated rocks. The consolidated rocks that yield the most water are lava flows such as basalt, which contains interconnected vesicular openings or fractures; limestone, which contains openings enlarged by solution; and sandstone, which contains interconnected openings between the grains that form the rock. Most of the wells that tap consolidated rocks are in the eastern and southern parts of the State, in areas where water supplies cannot be obtained readily from unconsolidated rocks.

More than 98 percent of the wells in Utah draw water from unconsolidated rocks. These rocks may consist of boulders, gravel, sand, silt, or clay, or a mixture of some or all of these sizes. Wells obtain the largest yields from the coarser materials that are sorted into deposits of equal grain size. Most wells that tap unconsolidated rocks are in large intermountain basins, which have been partly filled with debris from the adjacent mountains.

TABLE 1

Areas of known or potential ground-water development in Utah

(locations are shown in fig. 1)

	Area	Type of water-bearing rocks
1.	Curlew Valley	Unconsolidated
2.	Park Valley	Do.
3.	Grouse Creek Valley	Do.
4.	Hansel Valley	Do.
5.	Blue Creek Valley	Do.
6.	Sink Valley	Do.
7.	Malad-lower Bear River Valley	Do.
8.	Area east of the Pilot Range	Do.
9.	East Shore area	Do.
10.	Jordan Valley	Do.
11.	Cache Valley	Do.
12.	Bear Lake Valley	Do.
13.	Upper Bear River Valley	Do.
14.	Ogden Valley	Do.
15.	Morgan Valley	Do.
16.	Park City area	Do.
17.	Kamas Valley	Do.
18.	Heber Valley	Do.
19.	North flank Uinta Mountains	Do.
20.	South flank Uinta Mountains	Do.
21.	Uinta Basin	Do.
22.	Tooele Valley	Do.
23.	Skull Valley	Do.
24.	Dugway area	Do.
25.	Fish Springs Flat	Do.
26.	Sevier Desert	Do.
27.	Rush Valley	Do.
28.	Cedar Valley	Do.
29.	Utah and Goshen Valleys	Do.
30.	Juab Valley	Do.
31.	Sanpete Valley	Do.
32.	Central Sevier Valley	Do.
33.	Upper Sevier Valleys	Do.
34.	Deep Creek Valley	Do.
35.	White Valley	Do.
36.	Snake Valley	Do.
37.	Pine Valley	Do.
38.	Wah Wah Valley	Do.
39.	Escalante Valley, Beryl-Enterprise district	Do.
40.	Escalante Valley, Milford area	Do.
41.	Beaver Valley	Do.
42.	Cedar City Valley	Do.
43.	Parowan Valley	Do.
44.	Upper Fremont Valley	Do.
45.	Lower Fremont Valley	Consolidated
46.	Spanish Valley	Unconsolidated
47.	Castle Valley (Grand County)	Do.
48.	Montezuma Creek area	Consolidated
49.	Kanab area	Unconsolidated
50.	St. George area	Do.
51.	Pavant Valley	Do.
52.	Colton area	Consolidated
53.	Scipio area	Do.
54.	Lisbon Valley	Do.
55.	Monticello area	Do.
56.	Blanding area	Do.
57.	Bluff area	Do.

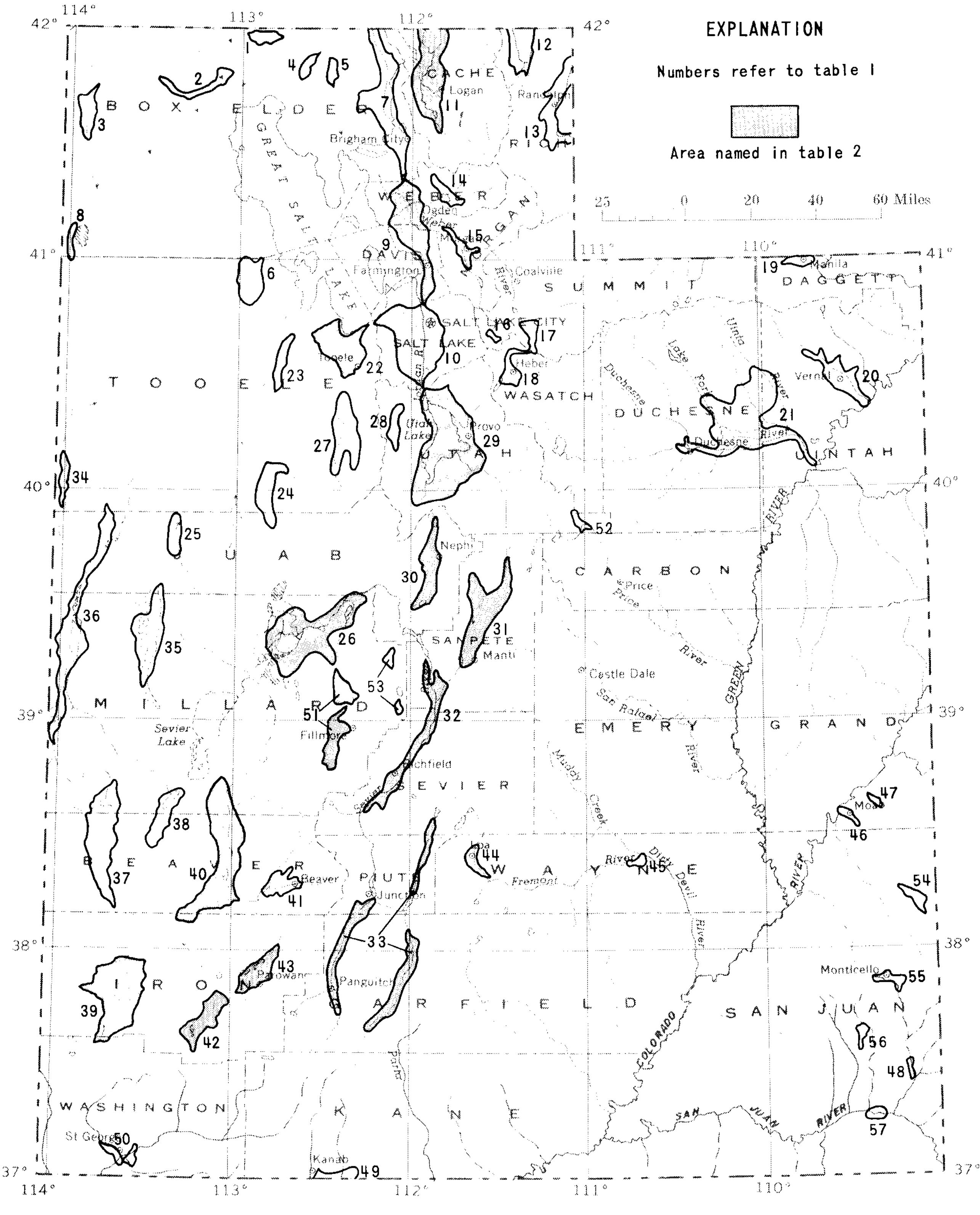

Figure 1.—Map of Utah showing areas of known or potential ground-water development.

SUMMARY OF CONDITIONS

The estimated total withdrawal of water from wells in Utah in 1972 was about 800,000 acre-feet, which is about 90,000 acre-feet more than for 1971 and about 200,000 more than for 1963 (table 3). The increases for both the 1- and 10-year periods were due chiefly to increased withdrawal for irrigation.

During 1972, precipitation was above normal in four of the State's seven climatic divisions (National Oceanic and Atmospheric Administration, 1973). However, precipitation was below normal for 5 of the first 6 months of 1972 for all Utah except the northern mountains. Ground-water levels were generally lower in the southwestern and central parts of Utah from February-March 1972 to February-March 1973 due to increased withdrawal for irrigation. Ground-water levels in northern Utah were variable, and no consistent pattern of water-level changes was evident.

For the 1963-72 period precipitation was near or above normal for six of the State's seven climatic divisions. Only in southeast Utah was precipitation below normal for the 10-year period. Ground-water levels generally rose in the north-central part of Utah from March 1963 to March 1973. In the southwestern and south-central parts of Utah, ground-water levels generally declined due to increased withdrawal for irrigation.

The larger ground-water basins and those containing most of the ground-water developments in Utah are shown in figure 1 and are listed in table 2, together with the information about the number of wells constructed and the withdrawal of water from wells during 1972. For comparison the withdrawal of water from wells during the 10-year period 1963-72 are shown in table 3. The discussions that follow summarize ground-water development and changes in ground-water conditions in the areas of major ground-water development.

Table 2.--Well construction and withdrawal of water from wells in 1972 in major areas of ground-water development in Utah.

Area	Number in figure 1	Number of wells completed[1/] Diameter: Less than 6 inches[2/]	Diameter: 6 inches or more[2/]	New large-withdrawal wells[3/]	Withdrawal from wells (acre-feet): Irrigation	Industry	Public supply	Domestic and stock	Total (rounded)
Cache Valley	11	14	10	2	10,800	7,000	3,400	2,100	23,300
East Shore area	9	15	15	1	4/16,400	6,900	18,100	-	41,400
Jordan Valley	10	5	19	4	5,100	5/40,600	45,300	6/33,500	124,500
Tooele Valley	22	1	15	5	4/25,600	800	2,700	100	29,200
Utah and Goshen Valleys	29	21	19	2	56,800	6,300	15,400	12,700	91,200
Juab Valley	30	6	4	3	29,400	50	0	150	29,600
Sevier Desert	26	13	3	0	36,700	700	1,500	1,000	39,900
Sanpete Valley	31	6	3	3	16,600	400	500	7/3,000	20,500
Upper and central Sevier Valleys	32,33	16	17	4	11,600	100	1,500	6,100	19,300
Pavant Valley	51	0	4	0	98,000	100	150	300	98,600
Cedar City Valley	42	1	14	10	1/33,500	500	800	150	34,900
Parowan Valley	43	0	4	3	1,8/27,500	300	100	150	28,000
Escalante Valley									
Milford area	40	0	0	0	9/57,600	300	800	600	59,300
Beryl-Enterprise district	39	0	17	11	1/76,400	0	100	600	77,100
Other areas		8	90	15	10/67,300	10/2,500	10/9,100	10/1,000	10/80,000
Totals (rounded)		106	234	63	569,000	67,000	99,000	62,000	797,000

1/ Data from Utah Department of Natural Resources, Division of Water Rights.
2/ Includes replacement wells.
3/ New wells (6 inches or more in diameter) constructed for irrigation, industrial, or public supply.
4/ Includes some domestic and stock use.
5/ Includes some use for air conditioning.
6/ Includes some use for fish and fish culture.
7/ Includes some use for irrigation.
8/ Includes some use for stock.
9/ Data for withdrawals for irrigation obtained from Milford Water Commissioner.
10/ Estimated minimum amount.

Table 3.--Withdrawal of water from wells during 1963-72 in major areas of ground-water development in Utah

(Thousands of acre-feet)

	Number in figure 1	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	Totals
Cache Valley	11	27	29	28	33	24	22	26	25	24	23	261
East Shore area	9	36	55	59	55	53	46	1/38	39	41	41	463
Jordan Valley	10	111	110	102	126	103	107	109	109	116	124	1,117
Tooele Valley	22	25	21	20	25	21	22	23	25	24	29	235
Utah and Goshen Valleys	29	86	75	73	98	80	74	78	83	86	91	824
Juab Valley	30	21	19	18	25	21	17	18	18	21	30	208
Sevier Desert	26	26	31	27	31	32	29	21	16	17	40	270
Sanpete Valley	31	13	16	12	21	15	13	15	14	16	20	155
Upper and central Sevier Valleys	32,33	20	18	18	20	19	19	20	19	19	19	191
Pavant Valley	51	80	72	69	88	77	63	75	71	79	99	773
Cedar City Valley	42	22	22	16	25	26	2/30	2/27	2/31	2/36	2/35	270
Parowan Valley	43	14	16	15	20	18	2/22	2/20	2/26	2/24	2/28	203
Escalante Valley												
Milford area	40	42	46	46	52	46	3/49	3/52	3/56	3/58	3/59	506
Beryl-Enterprise district	39	64	72	70	79	71	2/74	2/84	2/70	2/75	2/77	736
Other areas		4/8	5/43	5/38	5/45	5/41	5/48	5/56	5/72	5/75	5/80	506
Totals (rounded)		600	640	610	740	650	640	660	670	710	800	6,720

1/ Previous to 1969, discharge by small-diameter wells estimated by different method.
2/ Includes data for withdrawals for irrigation obtained from Utah Department of Natural Resources, Division of Water Rights.
3/ Includes data for withdrawals for irrigation obtained from Milford Water Commissioner.
4/ Includes only Beaver and Cedar Valleys.
5/ Estimated minimum amount.

MAJOR AREAS OF GROUND-WATER DEVELOPMENT

CACHE VALLEY

by L. J. Bjorklund and L. J. McGreevy

The withdrawal of water from pumped and flowing wells during 1972 was about 23,300 acre-feet as compared to 23,500 acre-feet in 1971 (Sumsion and others, 1972, p. 8) and 24,800 acre-feet in 1970 (Cordova and others, 1971, p. 8). The principal reason for less withdrawal during 1971 and 1972 than during 1970 was that more surface water was available for irrigation. The increased availability of surface water is indicated by the relatively high discharge of the Logan River in 1971 and 1972. Figure 2 shows the long-term trend of the water level in well (A-12-1)29cab-1 near Logan, the annual discharge of the Logan River near Logan, and the cumulative departure from the 1931-60 normal annual precipitation at Logan. The water level in well (A-12-1)29cab-1 reflects the general trend of water levels in Cache Valley.

Water levels in Cache Valley declined from March 1972 to March 1973 (fig. 3). The decline in most of the area was less than 2 feet and was probably due to the slightly less-than-normal precipitation during 1972.

From March 1963 to March 1973 water levels rose in most of Cache Valley (fig. 4). Rises were generally less than 3 feet and are attributed to above-normal precipitation during 8 of the 10 years since 1963.

EAST SHORE AREA

by E. L. Bolke

The withdrawal from wells in the East Shore area in 1972 was about 41,400 acre-feet, 800 acre-feet more than that reported for 1971 (Sumsion and others, 1972, p. 9) and 5,200 acre-feet more than that reported for 1963 (Arnow and others, 1964, p. 20). The increases were due chiefly to pumpage for public supply and industry.

From March 1972 to March 1973 water levels declined in about 60 percent of the East Shore area (fig. 5). Most of the declines were less than 2 feet. The largest declines, more than 4 feet, occurred in the Bountiful area and may be due to local pumping effects. The largest rises, more than 4 feet, occurred near Syracuse. Most of the rises elsewhere were less than 2 feet.

The long-term relation between water levels in selected wells and precipitation at Ogden Pioneer powerhouse is shown in figure 6. Water-level changes in the East Shore area from March 1963 to March 1973 and from March 1953 to March 1973 are shown in figures 7 and 8 respectively.

Water levels declined in the northern two-thirds of the East Shore area from March 1963 to March 1973. The largest declines, more than 15 feet, occurred north of Ogden. In the southern one-third of the area, water levels rose during the period. The largest rises, more than 15 feet, occurred near Bountiful and Kaysville. Declines in water levels in the heavily pumped area around Hill Air Force Base ranged from 5 to 10 feet. The rise in water levels in the southern part of the East Shore area is due partly to importation of water from the Weber Basin, allowing for less withdrawal of ground water by wells in this part of the area, and partly to above-normal precipitation during most of the period.

From March 1953 to March 1973 water levels declined in the East Shore area except for small areas near North Ogden, Plain City, and Willard. The declines are due chiefly to pumping for public supply and industry; the largest declines, more than 40 feet, occurred in the area near Hill Air Force Base.

JORDAN VALLEY

by R. W. Mower

The withdrawal of water from wells in Jordan Valley in 1972 was 124,500 acre-feet, an increase of 8,500 acre-feet (about 7 percent) over that in 1971 (Sumsion and others, 1972, p. 10) and 14,500 acre-feet (about 13 percent) more than that reported for 1963 (Arnow and others, 1964, p. 27). The largest increase in withdrawals was for public supply, which was 45,300 acre-feet in 1972. The increased use for public supply was due to increased population (fig. 9) and to above-normal temperatures during the summer of 1972, which resulted in more lawn watering than during 1971. The mean annual temperature recorded during 1972 at the Salt Lake City WSFO (International Airport) station was 1.4°F (0.8°C) above normal and the mean annual temperature recorded for the three summer months was 2.0°F (1.1°C) above normal. The withdrawal for irrigation in 1972 was about 16 percent more than in 1971 due to above-normal temperature, increased use on lands not irrigated with surface water, and to less surface water available for irrigation.

Water levels declined from February 1972 to February 1973 in about 60 percent of Jordan Valley (fig. 10) and rose in about 40 percent; the average change in water level in the valley was a decline of 0.6 foot. The maximum observed decline was more than 10 feet in two small areas, one in the north part of Salt Lake City and the other near Lark. The maximum observed rise was slightly more than 2 feet in areas near the south part of Salt Lake City, southwest of Kearns, and south of Herriman. The maximum rises occurred in areas where the volume of recharge was greater than normal due to above-normal precipitation and where pumping was relatively light. The declines were due to increased pumping for public supply and industry in areas of relatively small recharge.

From February or March 1963 to February 1973 water levels rose in about 97 percent of the Jordan Valley (fig. 11). The largest rises, more than 15 feet, were in the south-central part of the valley near Riverton and in the northeast part of Salt Lake City. Declines of slightly less than 3 feet occurred in two small areas, one near the northwest part of Salt Lake City and the other between Murray and Midvale. Although withdrawals were at an alltime high during the 10-year period (fig. 9), the average change in water level over the valley was a rise of 3.4 feet, probably because precipitation (figs. 9 and 12), and therefore recharge, was greater than it was during the previous 10 years (1953-62).

The relation between fluctuations of precipitation and water levels in selected wells is illustrated in figure 12. Precipitation at Silver Lake Brighton during 1972 was about 2 inches above normal, and the cumulative departure at the end of 1972 was about 43 inches above the 1931-60 normal. Precipitation, which was only slightly above normal during 1972, and moderately increased withdrawals in most parts of the valley are reflected by a slight decline of water levels in four of the five wells from March 1972 to March 1973. During the 1963-73 period there were slight declines in two of the five wells. The declines represent the effects of increased withdrawals, chiefly for public supply, and the rises represent the effects of increased recharge.

TOOELE VALLEY

by L. R. Herbert

The withdrawal of 29,200 acre-feet of water from wells in Tooele Valley in 1972 was about 5,200 acre-feet more than reported for 1971 (Sumsion and others, 1972, p. 11) and about 4,200 acre-feet more than reported for 1963 (Arnow and others, 1964, p. 32). The increases were due chiefly to pumpage for irrigation.

The discharge from springs in 1972 was approximately 14,700 acre-feet, an increase of 1,000 acre-feet over the previous year. About 2,300 acre-feet of springflow was used for irrigation and stock in the valley, and about 12,400 acre-feet was diverted to Jordan Valley for industrial use.

Water levels rose in most of Tooele Valley from March 1972 to March 1973 (fig. 13) due to above-normal precipitation during 1972. Water-level declines occurred in the Grantsville district due to heavy pumping.

The long-term relation between water levels in selected wells and precipitation at Tooele is shown in figure 14. The water level in well (C-2-4)33add-1 best shows this relationship for the eastern part of Tooele Valley, and the water level in well (C-2-6)36dcc-1 best shows the relationship for the western part.

Water levels rose in most of Tooele Valley from March 1963 to March 1973 (fig. 15) because of above-normal precipitation during 8 of the 10 years. Water levels declined in the Grantsville district and elsewhere where heavy pumping occurred.

UTAH AND GOSHEN VALLEYS

by L. L. Miller

Withdrawal of water from wells in Utah and Goshen Valleys in 1972 was 91,200 acre-feet, which is 5,000 acre-feet more than that reported for 1971 (Sumsion and others, 1972, p. 12) and 5,200 acre-feet more than that reported for 1963 (Arnow and others, 1964, p. 38 and 47). Withdrawals for irrigation and public supply were greater by 2,900 and 1,900 acre-feet, respectively, and accounted for most of the increase from 1971 to 1972. In Utah Valley, 72,600 acre-feet of water was withdrawn in 1972, an increase of about 2,400 acre-feet compared to 1971; in Goshen Valley, 18,600 acre-feet of water was withdrawn in 1972, an increase of about 2,600 acre-feet compared to 1971.

Water levels in most observation wells in Utah and Goshen Valleys declined from March 1972 to March 1973 (figs. 16, 17, 18, 19, and 20). The general decline was due to increased ground-water withdrawal in 1972.

Water levels for the 10-year period March 1963 to March 1973 rose in most observation wells (fig. 21). Water levels rose because the annual precipitation was generally above normal during the period. The intensive use of ground water for public supply in the Provo area and for irrigation in Goshen Valley probably accounts for the declines in most observation wells in these areas.

JUAB VALLEY

by R. G. Butler

The discharge from pumped and flowing wells in Juab Valley during 1972 was about 29,600 acre-feet, an increase of 8,500 acre-feet from that reported for 1971 (Sumsion and others, 1972, p. 12) and an increase of 8,800 acre-feet from that reported for 1963 (Arnow and others, 1964, p. 51 and 55). These increases were due chiefly to increased pumpage for irrigation.

From March 1972 to March 1973 (fig. 22) water levels declined more than 8 feet in the Nephi area and more than 6 feet in the Levan area and north of Mona. The declines were due to increased pumping during 1972. A slight rise was observed in a well about 4 miles northwest of Levan in an area of very little ground-water withdrawal.

The long-term relation between water levels in selected wells and the cumulative departure from the 1931-60 normal annual precipitation at Nephi and Levan is shown in figure 23. The water levels in wells (D-11-1)9bbb-4 and (C-15-1)12aba-1 generally fluctuate with changes in precipitation at Nephi and Levan, respectively. Exceptions to this relationship occur when pumpage during the year increases significantly over the previous year, as during 1966 and 1972 (see table 3). In such years, water levels decline due to increased pumping.

From March 1963 to March 1973 (fig. 24) water levels rose over most of Juab Valley. Rises of more than 4 feet occurred west of Nephi. The rises were due to above-normal precipitation during the 10-year period. Declines of more than 4 feet occurred in localized areas north of Mona and southwest of Levan. The declines were due to increased pumping for irrigation.

SEVIER DESERT

by R. W. Mower

The withdrawal of water from wells in the Sevier Desert in 1972 was about 39,900 acre-feet, the largest amount ever withdrawn. This amount was 22,800 acre-feet (about 133 percent) more than was reported for 1971 (Sumsion and others, 1972, p. 13) and 13,900 acre-feet more than that reported for 1963 (Arnow and others, 1964, p. 57). The increases were due chiefly to pumpage for irrigation. Pumpage for irrigation in 1972 increased about 170 percent from the amount in 1971 because several irrigation wells were used for the first time, and because surface water was less plentiful in 1972. During the 1972 water year, discharge of the Sevier River near Juab, the nearest station above all diversions in the Sevier Desert, was 145,300 acre-feet, about 39,100 acre-feet or about 20 percent less than during 1971.

Water levels in both the lower and upper artesian aquifers declined from March 1972 to March 1973 in most parts of the Sevier Desert (figs. 25 and 26). The maximum water-level decline in the lower artesian aquifer was slightly more than 6 feet in an area of almost 200 square miles, extending from near Lynndyl southwestward to about 4 miles west of Hinckley and encompassing most of the irrigated area. The maximum decline in the upper artesian aquifer also was slightly more than 6 feet, but in only one small area about 9 miles northwest of Delta. Maximum water-level rises were less than 2 feet in the upper artesian aquifer southeast of Delta, and no rises were observed in the lower artesian aquifer.

Observed water levels in both the lower and upper artesian aquifers declined from March 1963 to March 1973 in the Sevier Desert (figs. 27 and 28). Maximum declines in the lower artesian aquifer exceeded 10 feet in an area of about 80 square miles surrounding Delta. Maximum declines in the upper artesian aquifer were more than 10 feet in two relatively small areas totaling about 5 square miles, one year Delta and the other about 9 miles northwest of Delta. Declines occurred even though the annual precipitation during 8 of the 10 years, 1963-72, was above normal (fig. 29). The declines were due to increased withdrawals from wells.

The long-term relation between fluctuation of precipitation at Oak City and water levels in selected wells is shown in figure 29. Although precipitation was slightly above normal at Oak City during 1972, water levels declined in all three observation wells from March 1972 to March 1973, indicating that the withdrawal from wells in 1972 was more than the recharge in some heavily pumped parts of the Sevier Desert. Water levels declined in all three observation wells from March 1963 to March 1973, which as above, indicates the effects of pumping.

SANPETE VALLEY

by R. G. Butler

The withdrawal of water from wells in Sanpete Valley during 1972 was about 20,500 acre-feet, or 4,400 acre-feet more than that reported for 1971 (Sumsion and others, 1972, p. 14) and 7,500 acre-feet more than during 1963 (Arnow and others, 1964, p. 64). The increases were due chiefly to pumpage for irrigation.

Water levels declined in most areas of Sanpete Valley from March 1972 to March 1973 (fig. 30). The area of greatest decline was in the central part of the valley where declines of more than 6 feet were observed. Water levels rose in the Moroni-Chester area where there are few pumped irrigation wells.

Hydrographs of water levels in two pumped irrigation wells and one small-diameter flowing well in Sanpete Valley and the long-term trend of precipitation at Manti are shown in figure 31. Water levels declined in all three wells from March 1972 to March 1973, although precipitation was above normal. The declines were due to increased pumping for irrigation.

Water levels were lower in the two irrigation wells in March 1973 than in March 1963 despite above-normal precipitation for most of this period. The lower water levels were due to increased pumping. The water level in the flowing well was slightly higher in March 1973 than in March 1963, probably in response to the above-normal precipitation. The net declines in water levels from March 1963 to March 1973 in the two irrigation wells are probably representative of the more heavily pumped areas of Sanpete Valley (fig. 32), while the water-level rise in the flowing well is probably representative of areas of lesser pumping.

THE UPPER AND CENTRAL SEVIER VALLEYS

by G. W. Sandberg

The withdrawal of water from wells in the upper and central Sevier Valleys was about 19,300 acre-feet in 1972, the same as for the previous year (Sumsion and others, 1972, p. 14), and 300 acre-feet less than that reported for 1963 (Arnow and others, 1964, p. 67 and 70).

The relation between water levels in selected wells, annual discharge of the Sevier River at Hatch, and precipitation at Richfield Radio KSVC and Panguitch are shown in figure 33. Although precipitation at Panguitch was above normal for the fourth consecutive year, the small amount of snow cover in the headwaters area of the Sevier River caused discharge to be below average for the third consecutive year in the Sevier River at Hatch. The discharge at Hatch was above average for only 4 of 10 years from 1963 to 1972.

From March 1972 to March 1973 water levels rose in three wells and declined in 22 wells (fig. 34). The greatest rise, 3.4 feet, was southwest of Spry, and the greatest decline, 10.9 feet, was north of Rubys Inn. Water levels declined in most of the wells because precipitation, although above normal for 1972, occurred chiefly in late summer storms that caused flash floods and did not contribute measurably to recharge.

Water levels rose in 19 wells and declined in seven wells from March 1963 to March 1973 (fig. 35). All the declines occurred in the upper Sevier area. Precipitation at Richfield was near or above normal during 8 of the 10 years from 1963 to 1972, and precipitation at Panguitch was near or above normal during 7 of the 10 years.

PAVANT VALLEY

by D. B. Adams

Withdrawal of water from wells in Pavant Valley in 1972 was 98,600 acre-feet, which was 19,800 acre-feet more than that reported for 1971 (Sumsion and others, 1972, p. 15) and 18,900 acre-feet more than that reported for 1963 (Arnow and others, 1964, p. 73). The increases were due chiefly to pumpage for irrigation. Little surface water was available for irrigation during 1972 because January-May precipitation was below normal.

From March 1972 to March 1973 water levels declined less than 4 feet over most of Pavant Valley, but in some areas of the Meadow and Flowell districts water levels declined more than 12 feet (fig. 36). The maximum declines were in areas where pumpage increased in 1972, where recharge was less than normal, and where surface-water supplies were deficient. Water levels rose in small isolated areas of McCornick, Greenwood, and Kanosh districts.

The relation between water levels in selected observation wells and cumulative departure from the 1931-60 normal annual precipitation at Fillmore is shown in figure 37. From March 1963 to March 1973 water levels declined in most of Pavant Valley (fig. 38). The greatest decline was more than 20 feet in the Greenwood district. The declines in the McCornick, Greenwood, Pavant, and Kanosh districts are due to the effects of long-term pumping. Most of the 10-year decline in the eastern part of the Flowell and Meadow districts occurred in 1972. The declines in 1972 were due to the unusually dry months during the early irrigation season when little surface water was available for irrigation, resulting in greatly increased pumpage.

Pumping rates and the quantity of water applied to irrigated fields in Pavant Valley affect the chemical quality of water withdrawn from wells (Handy and others, 1970, p. D229-D230). The concentration of dissolved solids in water from selected wells in the valley is shown in figure 39. The concentration of dissolved solids has generally increased from 1963 to 1972 in water from those wells where data are available.

CEDAR CITY VALLEY

by G. W. Sandberg

The withdrawal of water from wells in Cedar City Valley in 1972 was about 34,900 acre-feet, or 800 acre-feet less than was reported for 1971 (Sumsion and others, 1972, p. 16) and 12,900 acre-feet more than that reported for 1963 (Arnow and others, 1964, p. 84). The 1-year difference is attributed to acreage adjustments of individual users. Water pumped for nonirrigation uses remained the same as for 1971. The 10-year increase is due chiefly to pumpage for irrigation.

Water levels rose in most of the northern part of the valley and declined in most of the southern part from March 1972 to March 1973 (fig. 40). The largest rises occurred in the Enoch area and in a small area west of Cedar City. The largest declines occurred north of Kanarraville and in a small area north of Cedar City.

The relations between water-level fluctuations in well (C-35-11) 33aac-1, cumulative departure from normal annual precipitation near Cedar City, annual discharge of Coal Creek, and annual pumpage for irrigation in the valley are shown in figure 41. Heavy local rains from August to December 1972 accounted for about 80 percent of the total annual precipitation recorded at Cedar City, but these rains did not increase the flow of Coal Creek or decrease the amount of water pumped for irrigation. Flow in Coal Creek in 1972 was the least of any year since 1963.

Water levels declined in most of the valley from March 1963 to March 1973 (fig. 42) due to increased pumping. Water levels rose, however, in the area of the Coal Creek alluvial fan northwest of Cedar City and in the vicinity of Kanarraville. The rise in water levels near the Coal Creek alluvial fan was probably due to recharge from Coal Creek. Precipitation was above normal during most of the 1963-72 period, and the discharge of Coal Creek in every year since 1963 was greater than in 1962.

PAROWAN VALLEY

by G. W. Sandberg

The withdrawal of water from wells in Parowan Valley was about 28,000 acre-feet in 1972, or 3,900 acre-feet more than reported for 1971 (Sumsion and others, 1972, p. 16) and 14,000 acre-feet more than reported for 1963 (Arnow and others, 1964, p. 88). The increases were due chiefly to pumpage for irrigation. Some irrigation wells in the northern part of the valley were pumped for the first time during 1972. Water pumped for industry (highway construction) remained about the same as 1971.

Water levels declined in most of the irrigated area of the valley from March 1972 to March 1973 (fig. 43). The maximum decline was more than 2 feet in areas west of Parowan and northwest of Paragonah. Water levels rose slightly in areas northeast of Paragonah, northwest of Parowan, and in the northern part of the valley near Fremont Wash where above-average runoff occurred in 1972.

The long-term relation between changes in water levels, precipitation, and pumpage for irrigation is shown in figure 44. Although precipitation at Parowan in 1972 was above normal, much of it was from heavy local summer rains that did not significantly add to the streamflow available for irrigation. Precipitation has been near or above normal during all but 1 year since 1963. Pumpage for irrigation has more than doubled during this period.

Water levels declined in most of the valley for which data are available from March 1963 to March 1973 (fig. 45). Declines of more than 7 feet occurred in the heavily pumped area north and northwest of Parowan. The decline in water levels was due to pumping for irrigation. Water levels rose in a small area northeast of Summit near the Little Salt Lake. The greatest rise was more than 7 feet.

ESCALANTE VALLEY

Milford area

by R. W. Mower

Withdrawal of water from wells in the Milford area in 1972 was 59,300 acre-feet, the highest of record. The 1972 withdrawal was 1,300 acre-feet more than reported for 1971 (Sumsion and others, 1972, p. 17) and 16,300 acre-feet more than that reported for 1963 (Arnow and others, 1964, p. 92). The increases were due chiefly to pumpage for irrigation.

From March 1972 to March 1973 (fig. 46) water levels in the Milford area generally declined south of Milford, due to increased pumping and because less surface water was available for irrigation. North of Milford water levels rose slightly during the period. Streamflow in the Beaver River was 19,120 acre-feet during the 1972 water year, or 3,900 acre-feet less than during the 1971 water year (fig. 47). Streamflow diverted for irrigation, and consequently water available for recharge in the areas irrigated with surface water, was less in 1972 than in any year since 1967 and aboat 30 percent less than the 1914-72 average.

The relations between water levels in well (C-29-10)6ddc-2, precipitation at Milford airport, discharge of the Beaver River, and pumpage for irrigation are shown in figure 47. The net decline of the water level from March 1963 to March 1973 in well (C-29-10)6ddc-2, near the middle of the heavily irrigated area, was caused by increased pumping and decreased availability of surface water during most of the period.

Water levels generally declined throughout the Milford area from March 1963 to March 1973 (fig. 48), except in two relatively small areas, one about 4 miles southeast of Milford and one near Minersville. Maximum declines of slightly more than 8 feet were observed about 8 miles south of Milford near the southern edge of the main area irrigated with ground water. Although annual precipitation during 7 of the 10 years, 1963-72, was above normal, water levels declined because of increased withdrawals from wells, and because streamflow in the Beaver River was below the 1914-72 average during 7 of the 10 years.

The general direction of ground-water movement in the Milford area is from the mountains toward the valley bottom, and thence northward, as indicated in figure 49. The general pattern of the contours shown in figure 49 did not change significantly between March 1962 (Arnow and others, 1964, p. 93) and March 1973.

Beryl-Enterprise district

by G. W. Sandberg

The withdrawal of water from wells in the Beryl-Enterprise district in 1972 was about 77,100 acre-feet, an increase of 2,200 acre-feet compared to the amount reported for 1971 (Sumsion and others, 1972, p. 17), and an increase of 12,600 acre-feet compared to the amount reported for 1963 (Arnow and others, 1964, p. 96). Pumpage for irrigation increased in 1972 by 2,200 acre-feet, and that for public supply, domestic, and stock uses remained the same as in 1971. The 10-year increase in withdrawal was due entirely to pumpage for irrigation.

Water levels declined throughout the district from March 1972 to March 1973 except for a small area near Enterprise (fig. 50). The declines were due to increased pumping for irrigation. The rise near Enterprise was due to recharge from Shoal Creek. The decline of water levels in the district from March 1972 to March 1973 was a continuation of the trend of the past decade.

From March 1963 to March 1973 (fig. 51) water levels declined in most of the Beryl-Enterprise district. The largest water-level decline was 18.5 feet about 4 miles northeast of Enterprise. Water-level rises near Enterprise during the 10-year period were due to recharge from Shoal Creek. Water levels in the south-central part of the district, where pumping is most concentrated, declined by 10 to 15 feet from March 1963 to March 1968 (Cordova and others, 1968, p. 94) but declined only about another 5 feet from March 1968 to March 1973.

The long-term relation between water levels in selected wells, precipitation, and pumpage for irrigation is shown in figure 52. The graphs show that the water level near Beryl Junction--wells (C-35-17) 25dcd-1 and (C-35-17)25cdd-1--has declined more than 40 feet since 1945 when pumping for irrigation first began. Most of the decline occurred during 1950-66, a period of below-normal precipitation, when pumping for irrigation increased. However, the general decline continued during 1967-71, when precipitation was above normal, indicating that the decline was due chiefly to pumping. The decline stopped temporarily during 1969-70 because of local recharge with mine-drainage water. The increased rate of decline during 1972 resulted from below-normal precipitation and increased pumping for irrigation.

Pumping has caused the water table to decline faster in the southern part of the district than in the northern part since about 1950. This decline caused the northward ground-water gradient to reverse in 1964 (Arnow and others, 1965, p. 91), creating a closed water-table depression in part of the district. The area of this closed depression, within the 5,105-foot contour, increased by about 16 times from October 1964 to October 1972 (fig. 53).

The effect of the reversed ground-water gradient has been to increase the amount of return seepage from irrigation that is recycled. Increased recycling of return seepage has resulted in an increased concentration of dissolved solids in the water. Figure 54 shows the change in concentration of dissolved solids in the water from four wells. The greatest overall increase in dissolved solids was at well (C-36-16) 5a-9 near the middle of the closed depression. Most of this increase occurred prior to the ground-water gradient reversal and was probably caused by irrigation return flow in the area of this well. Concentrations of dissolved solids in well (C-34-16)28dcc-2, near the northern edge of the expanding depression, have increased at least since 1967. The concentration of dissolved solids in well (C-37-17)12bdc-1, near the southern edge of the closed depression, increased from 1957 to 1970 and decreased thereafter. The concentration of dissolved solids of water in well (C-36-15)7dcc-1, on the east side of the district, showed no apparent change from 1957 to 1959, but three of the four measurements since 1965 have shown an increased concentration.

OTHER AREAS

by R. C. Butler

Estimated total withdrawal of water from wells in areas of Utah outside the major developed ground-water basins was about 80,000 acre-feet in 1972. This amount is 5,300 acre-feet more than that reported for 1971 (Sumsion and others, 1972, p. 18); the increase is due, for the most part, to more water being pumped for irrigation.

From March 1972 to March 1973 water levels rose due to above-normal precipitation in upper Fremont, Bear Lake, Heber, Park, and Beaver Valleys and in the St. George area (fig. 55). Water levels rose in the Blanding and Dugway areas, Uinta Basin, and the south flank of the Uinta Mountains, although precipitation was below normal. Water levels declined in Curlew, Ogden, Snake, and Cedar Valleys due to below-normal precipitation. Water levels declined in Grouse Creek Valley and in the Monticello area, although precipitation was above normal.

March 1963 to March 1973 (fig. 55) water levels rose in most of the "other areas" of Utah due to above-normal precipitation. In Beaver, Grouse Creek, and Curlew Valleys water levels declined locally due to pumping for irrigation. Water levels in the Uinta Basin and on the south flank of the Uinta Mountains changed relatively little during the 10-year period.

Water levels in Snake Valley have not changed significantly during the period 1964 to March 1973. Water-level contours for March 1973 are shown in figure 56. Water-level contours for 1964 are shown by Hood and Rush (1965, pl. 1).

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ILLUSTRATIONS

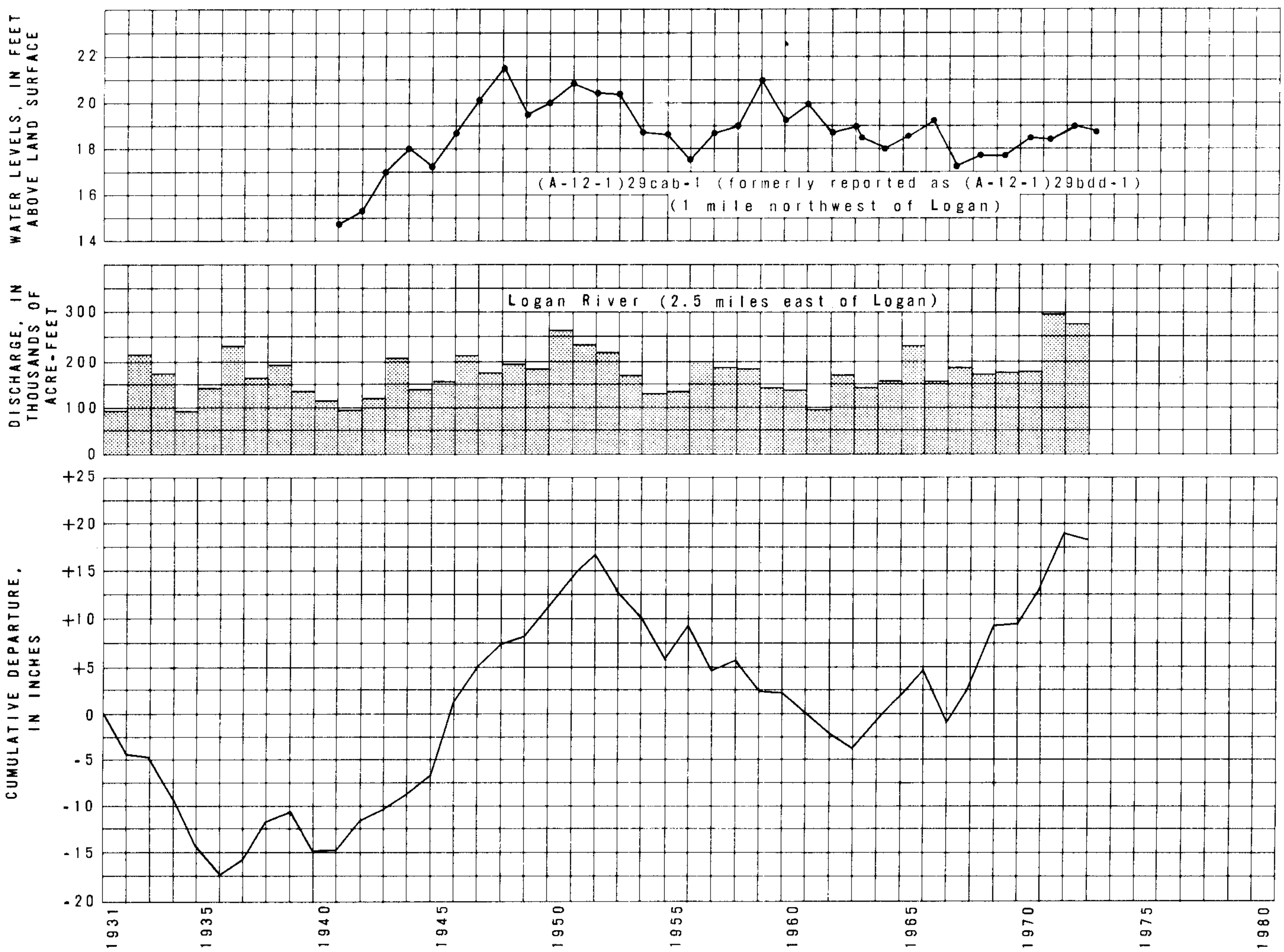
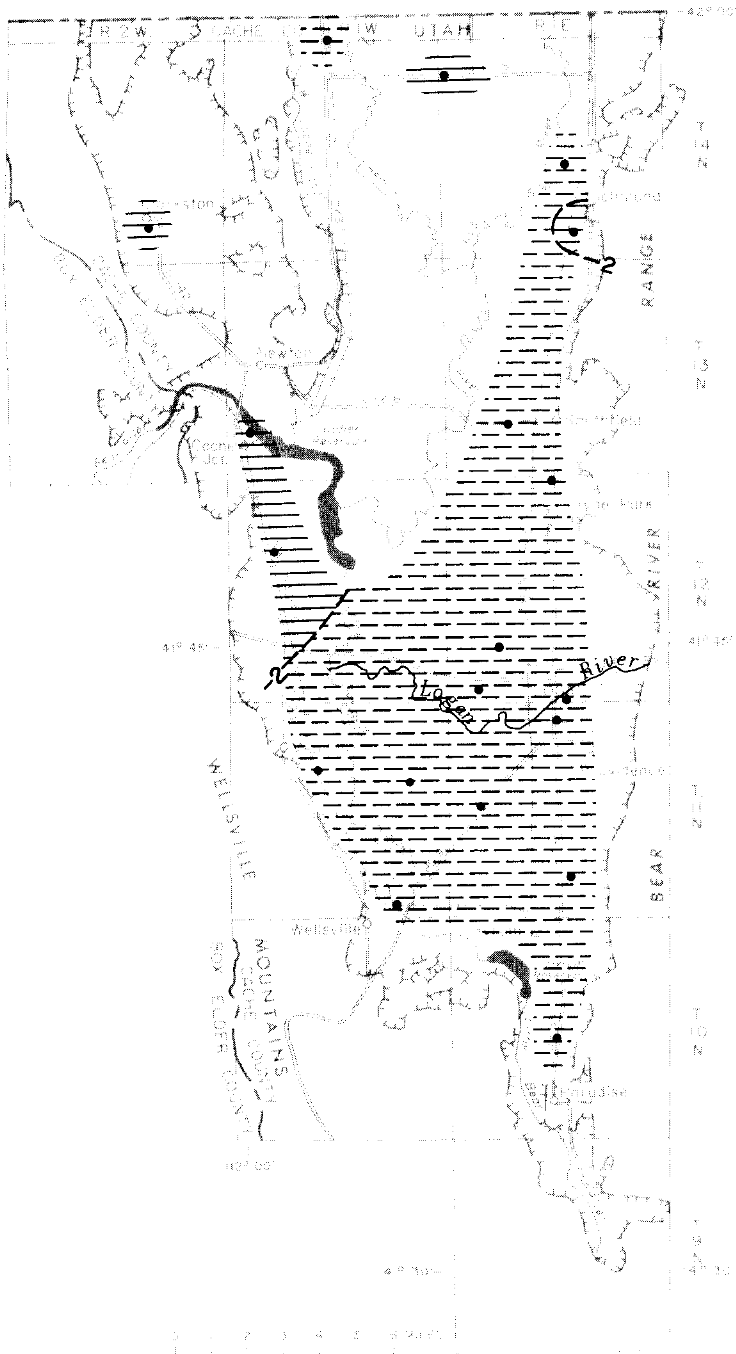


Figure 2.— Relation of water levels in well (A-12-1)29cab-1 to discharge of the Logan River near Logan and to cumulative departure from the 1931-60 normal annual precipitation at Logan Utah State University.



EXPLANATION

— — — — 2 — — — —
Line of approximate equal change of water level, in feet, March 1972 to March 1973

Decline

0-2 feet

More than 2 feet

•
Observation well

Approximate boundary of valley fill

by L. J. Bjorklund and L. J. McGreevy

Figure 3.—Map of Cache Valley showing change of water levels from March 1972 to March 1973.

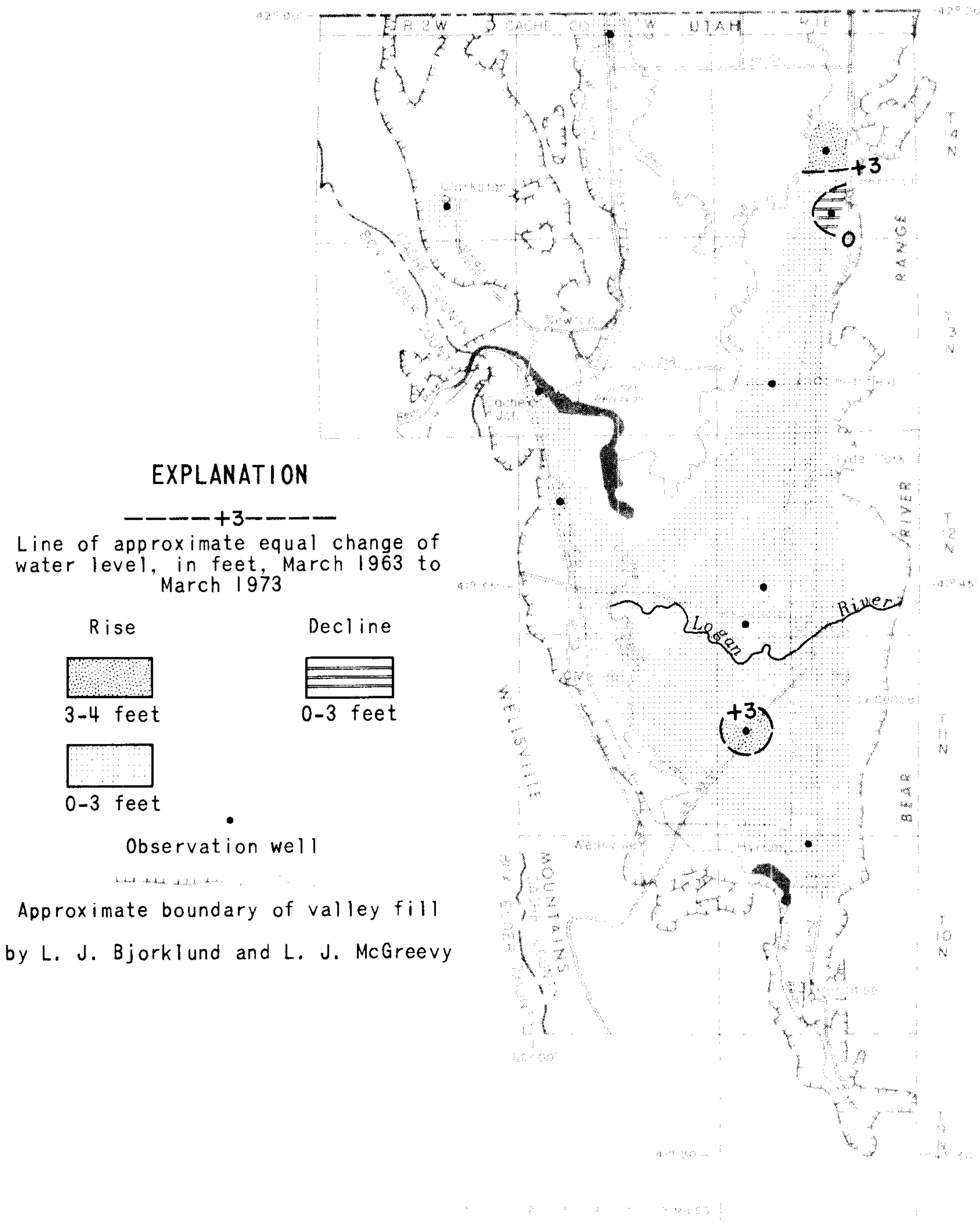


Figure 4.— Map of Cache Valley showing change of water levels from March 1963 to March 1973.

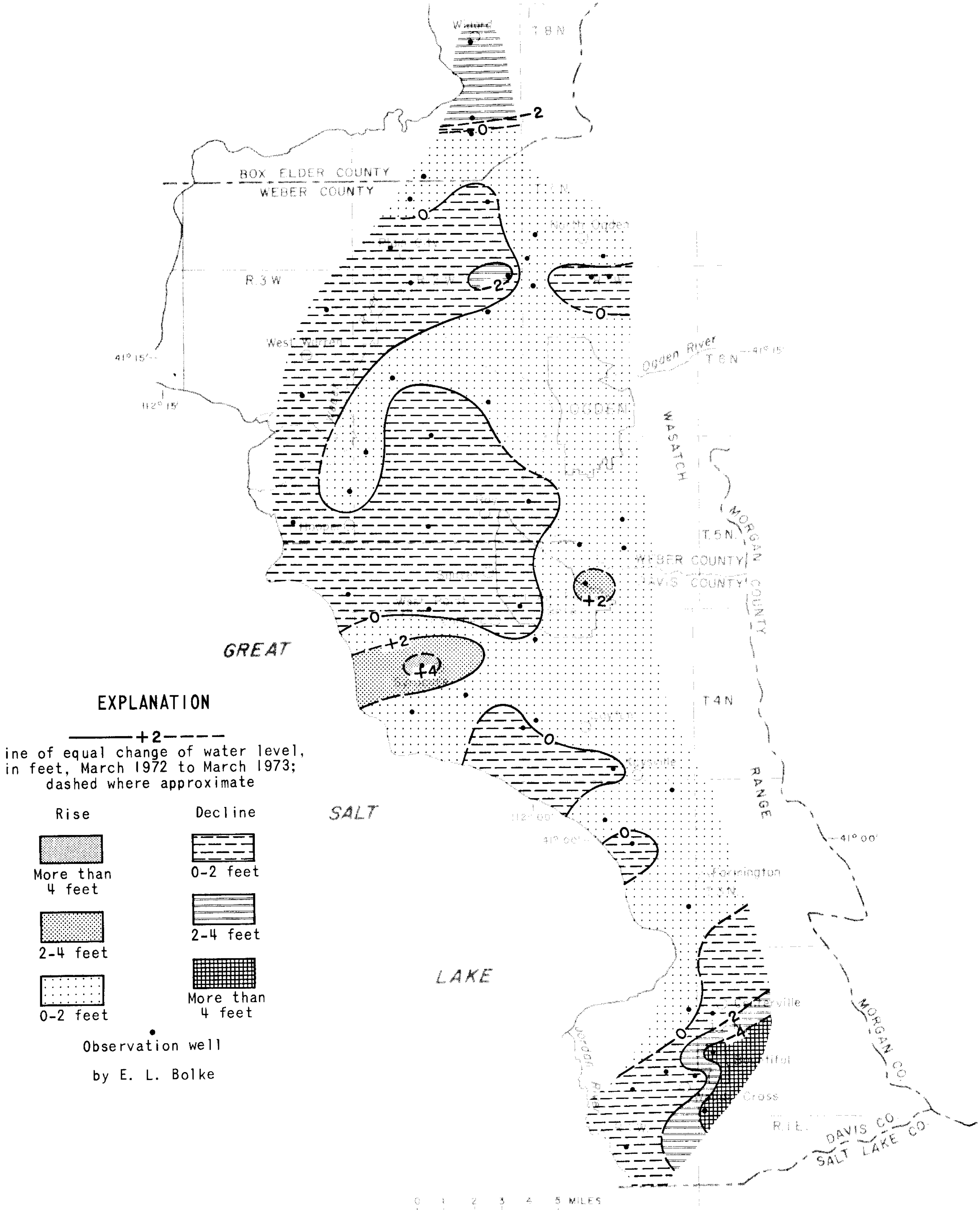


Figure 5.—Map of the East Shore area showing change of water levels from March 1972 to March 1973.

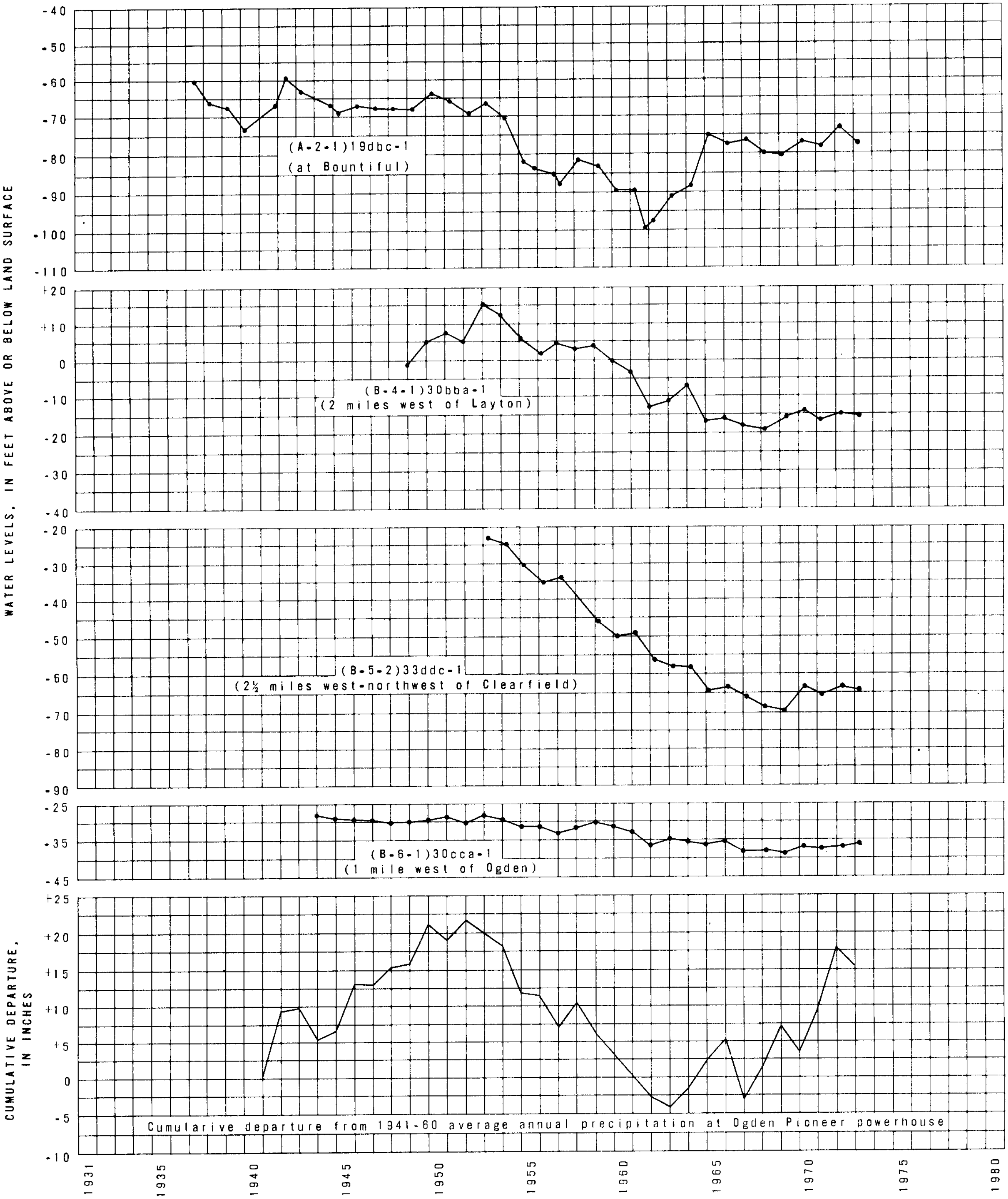


Figure 6.— Relation of water levels in wells near Bountiful, Layton, Clearfield, and Ogden to cumulative departure from the average annual precipitation at Ogden Pioneer powerhouse.

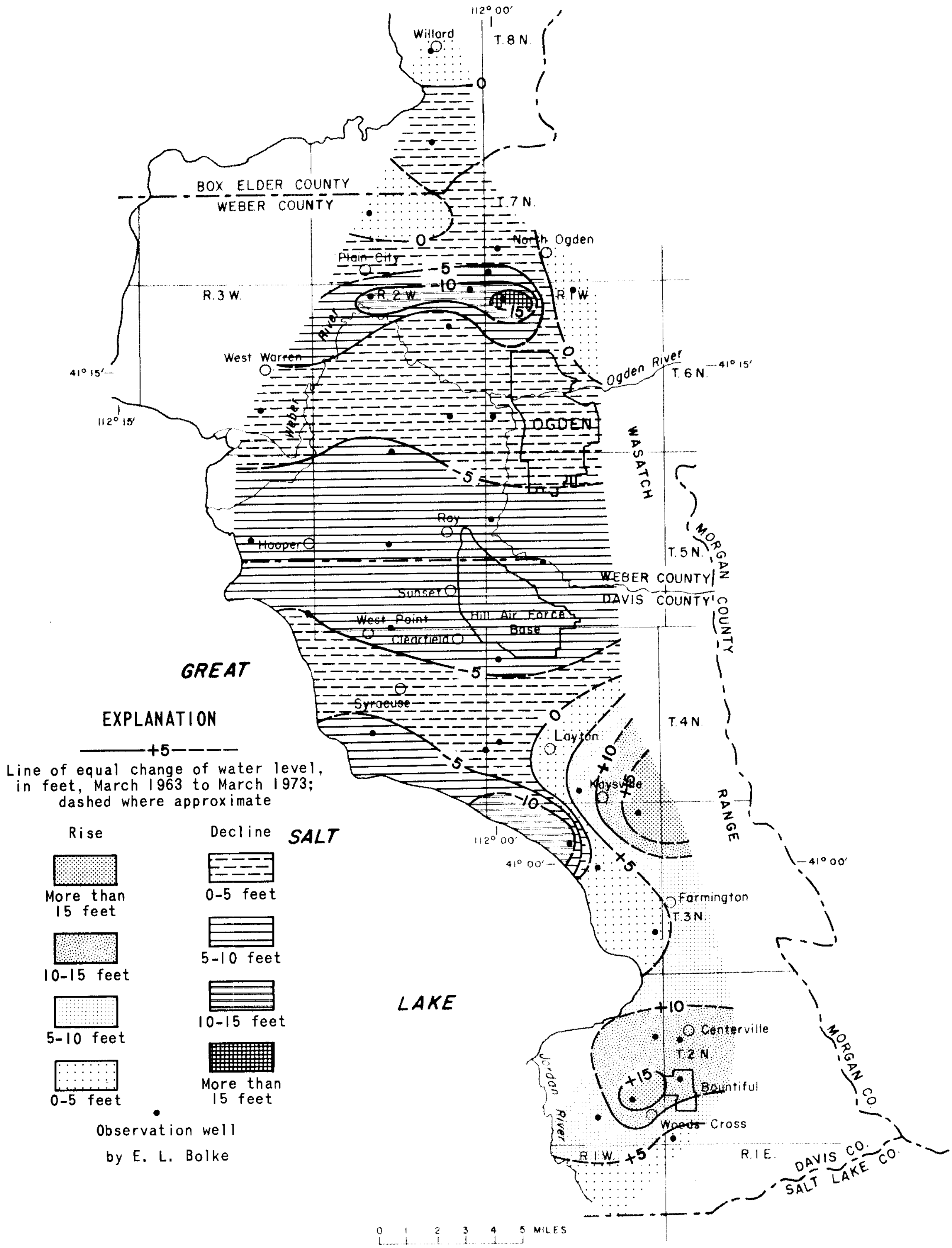


Figure 7.– Map of the East Shore area showing change of water levels from March 1963 to March 1973.

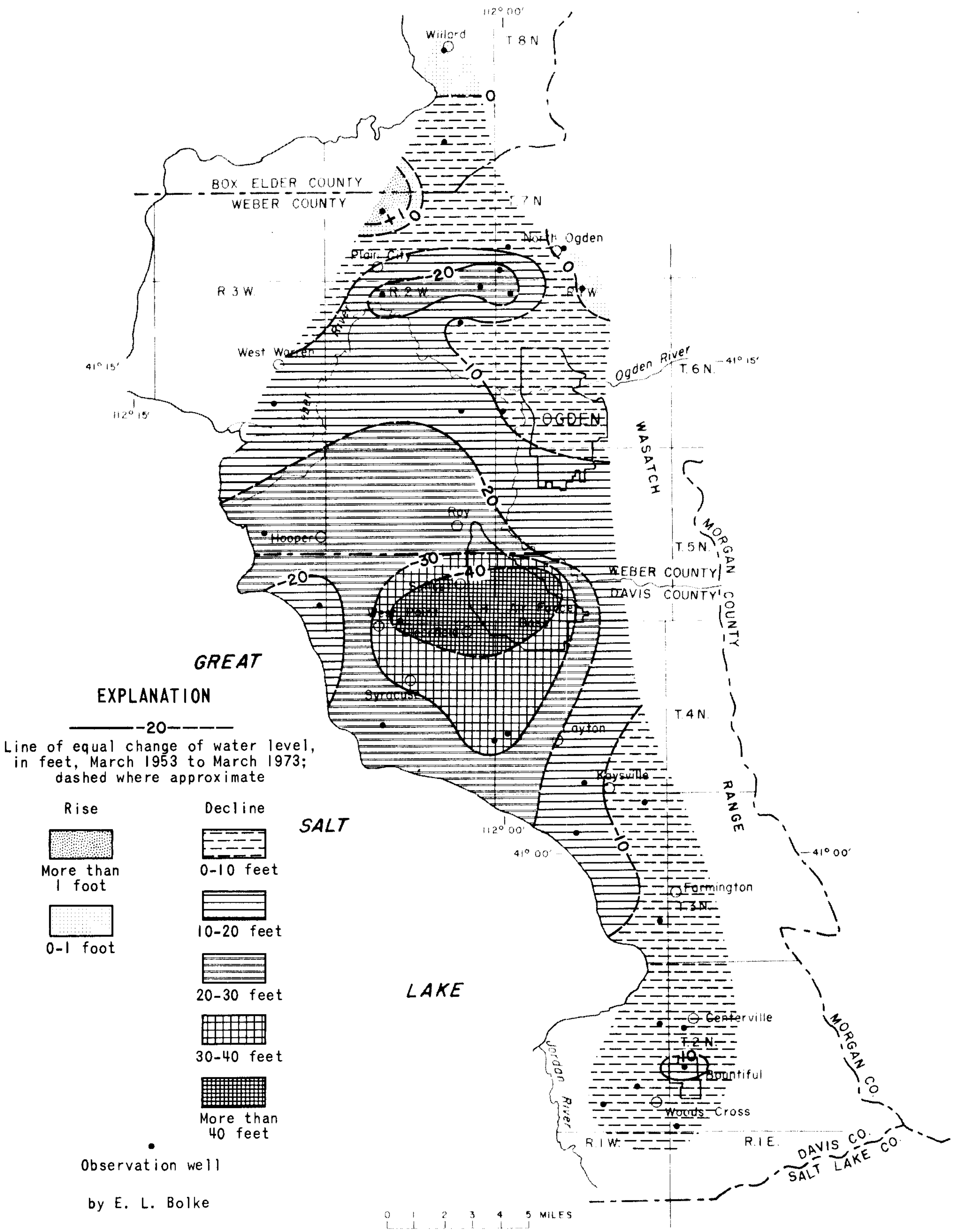


Figure 8.— Map of the East Shore area showing change of water levels from March 1953 to March 1973.

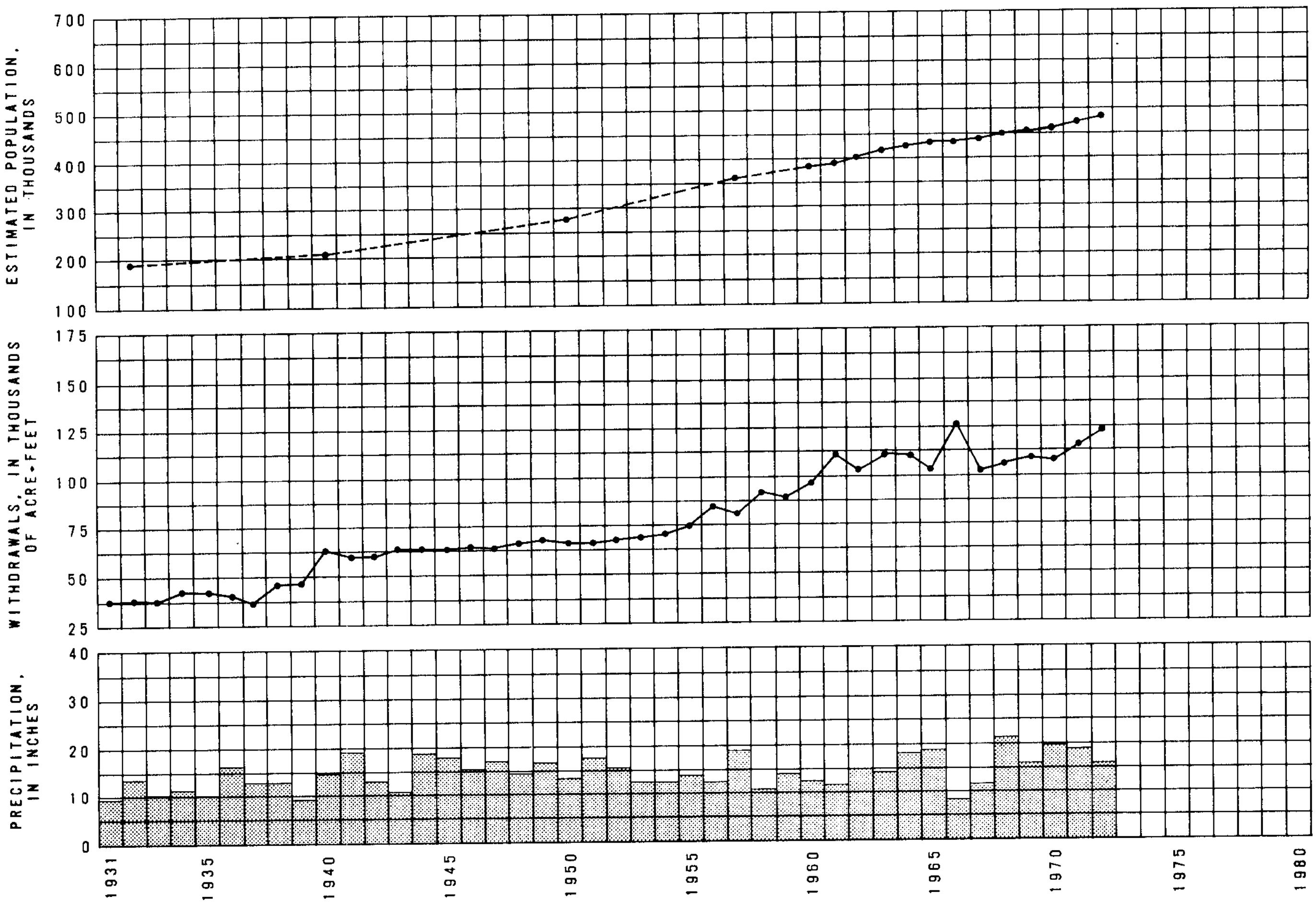


Figure 9.—Graphs showing estimated population of Salt Lake County, water withdrawals from wells, and annual precipitation at Salt Lake City WFSO (International Airport), 1931-72.

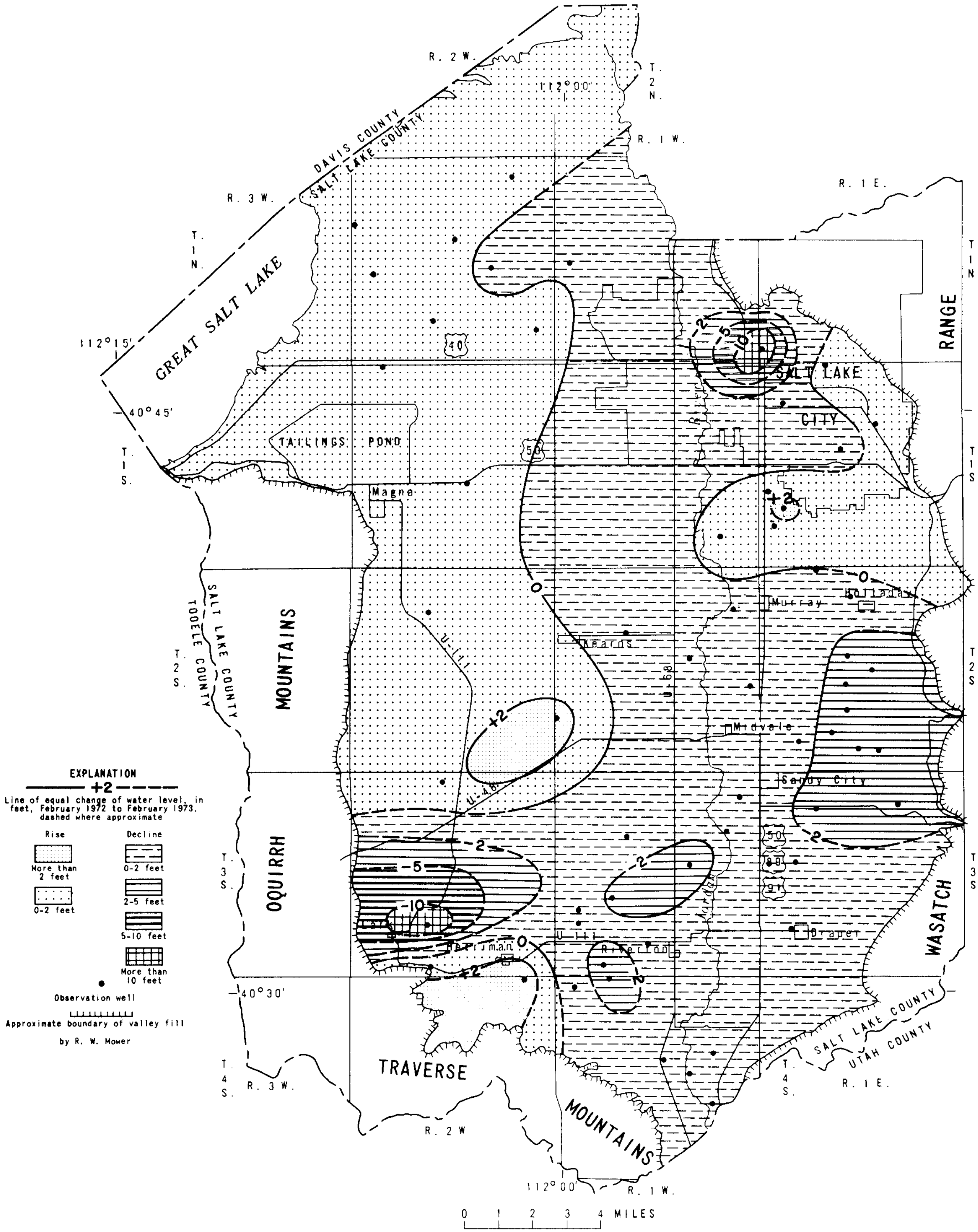


Figure 10.—Map of the Jordan Valley showing change of water levels from February 1972 to February 1973.

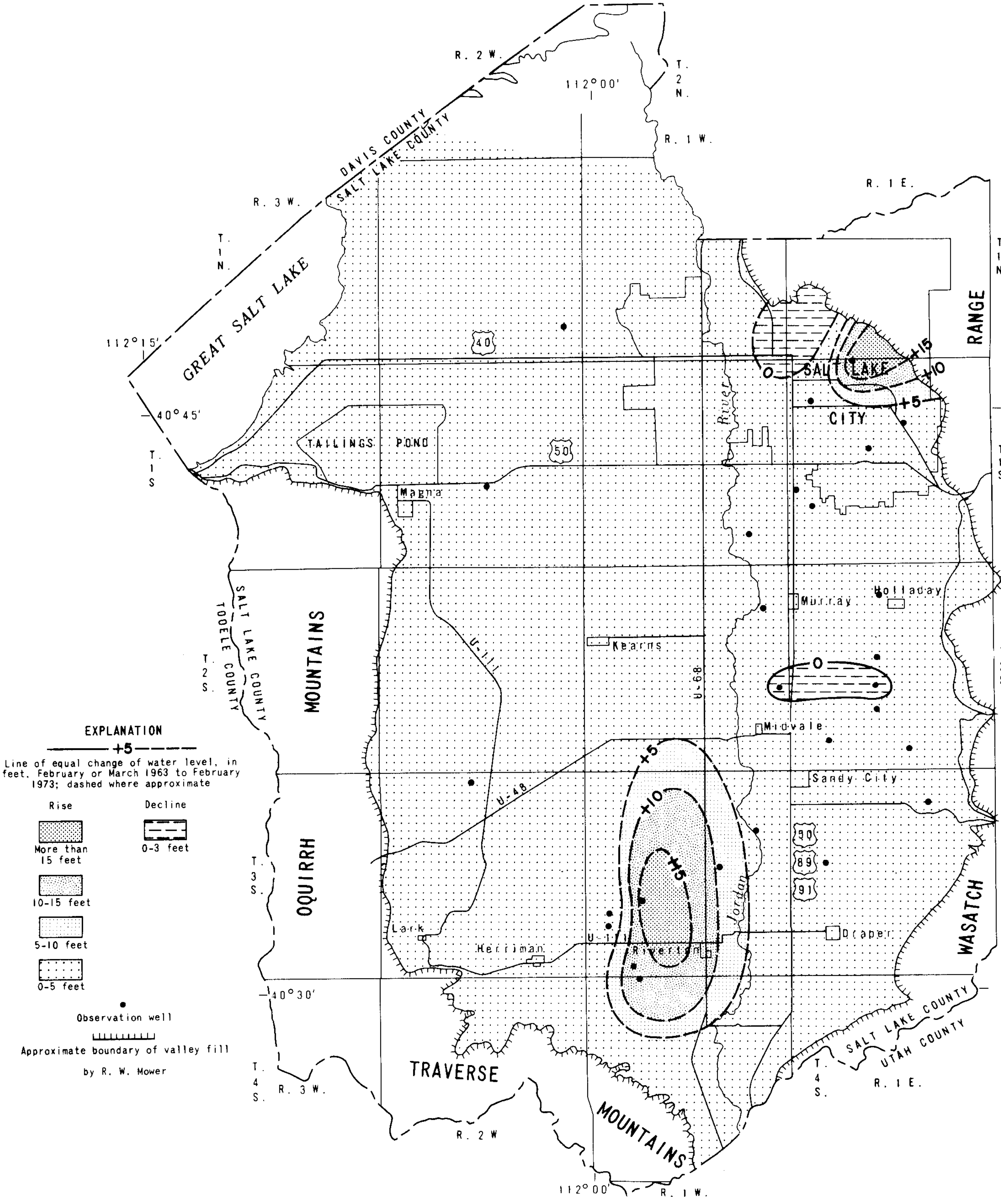


Figure 11.—Map of the Jordan Valley showing change of water levels from February or March 1963 to February 1973.

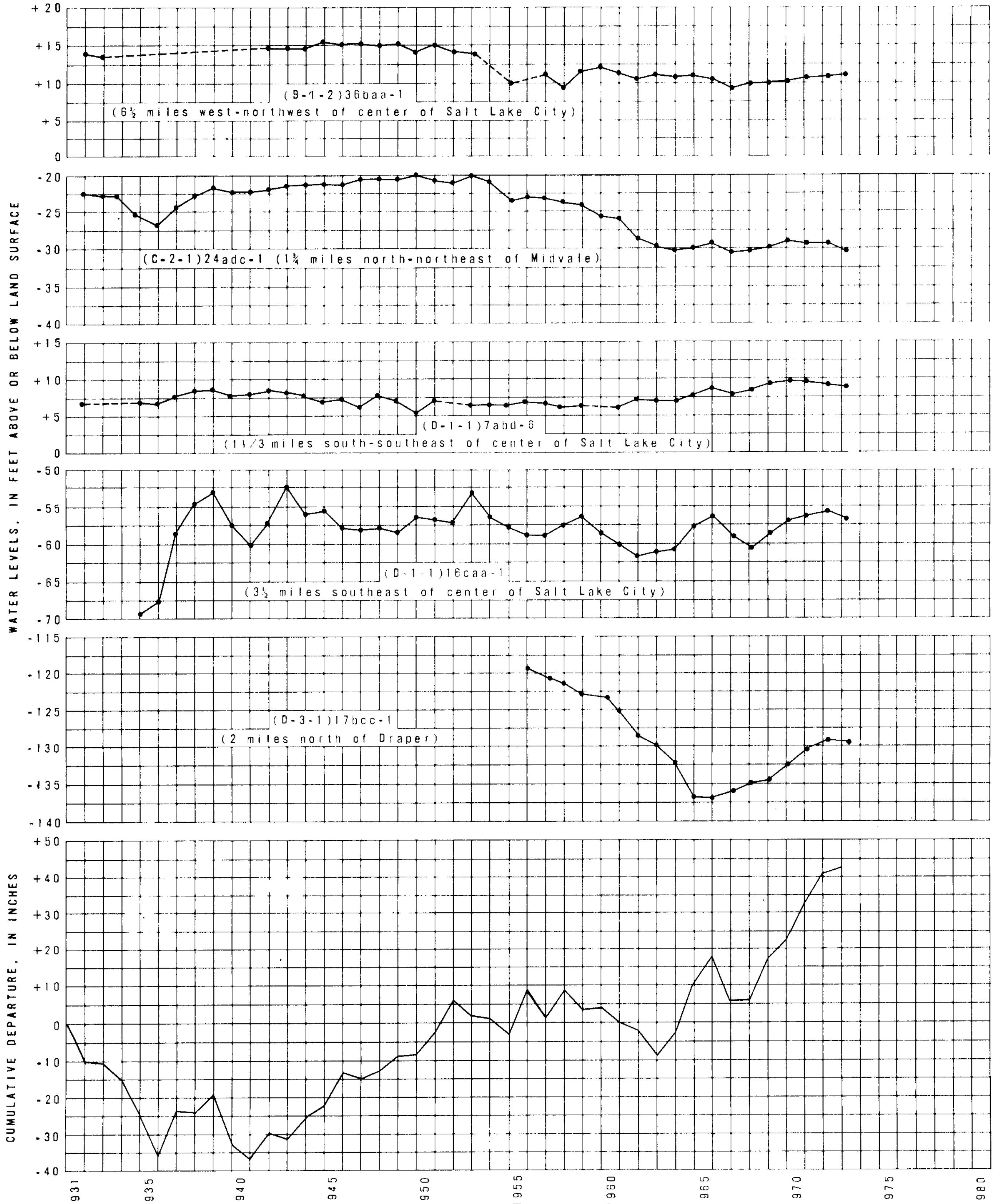


Figure 12.— Relation of water levels in selected wells in the Jordan Valley to cumulative departure from the 1931-60 normal annual precipitation at Silver Lake Brighton.

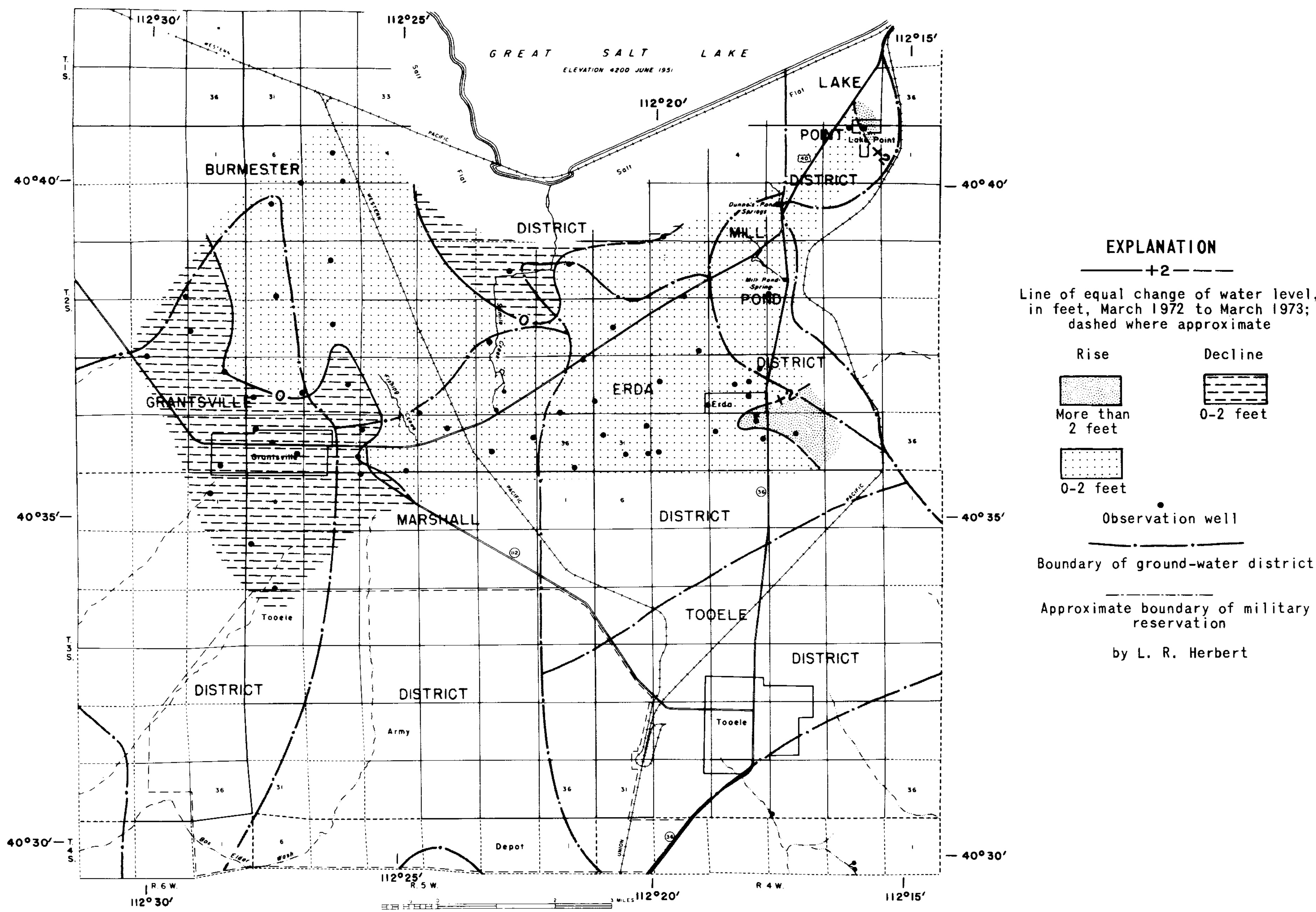


Figure 13.— Map of Tooele Valley showing change of water levels in artesian aquifers from March 1972 to March 1973.

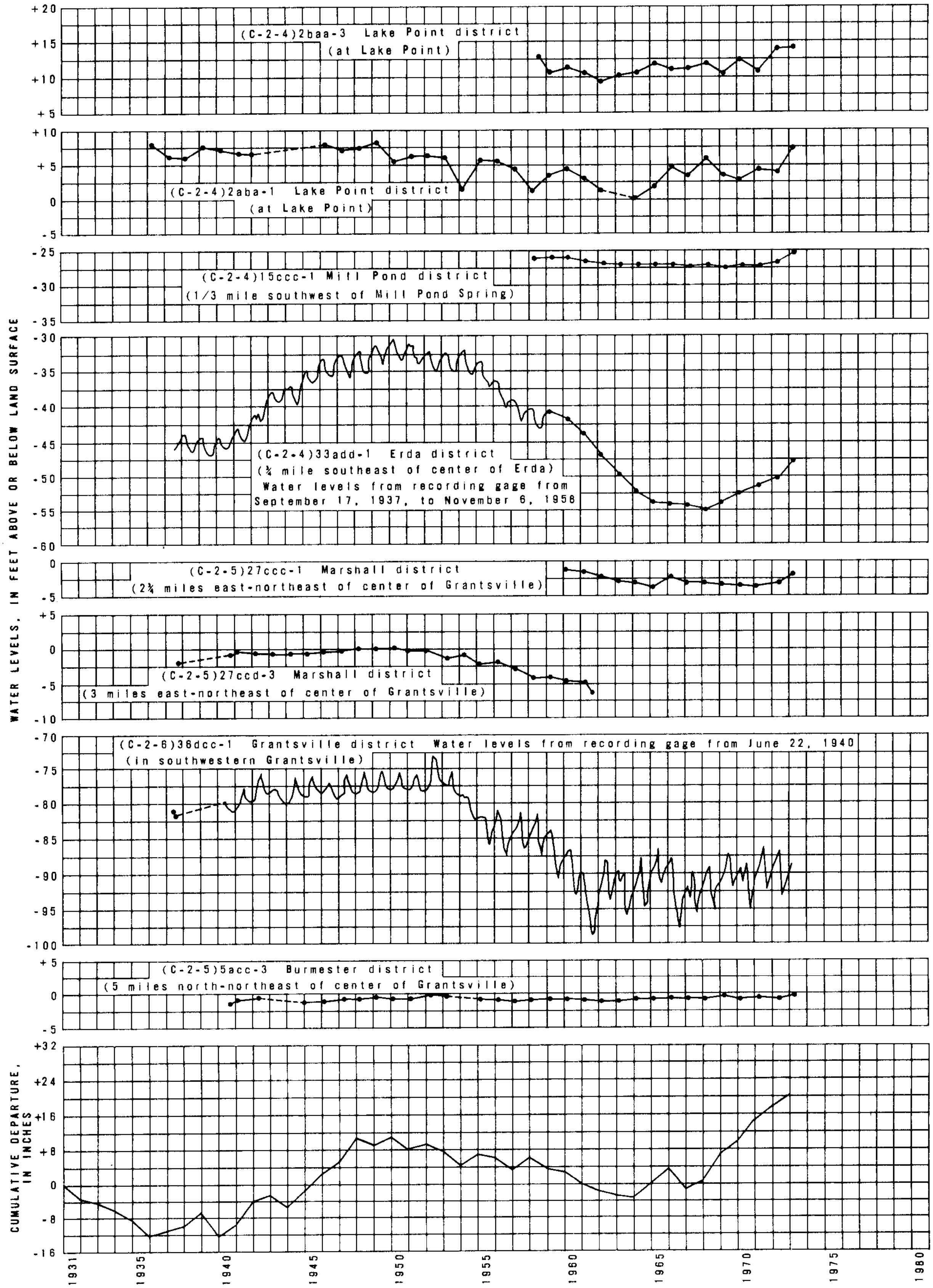


Figure 14.— Relation of water levels in selected wells in Tooele Valley to cumulative departure from the 1931-60 normal annual precipitation at Tooele.

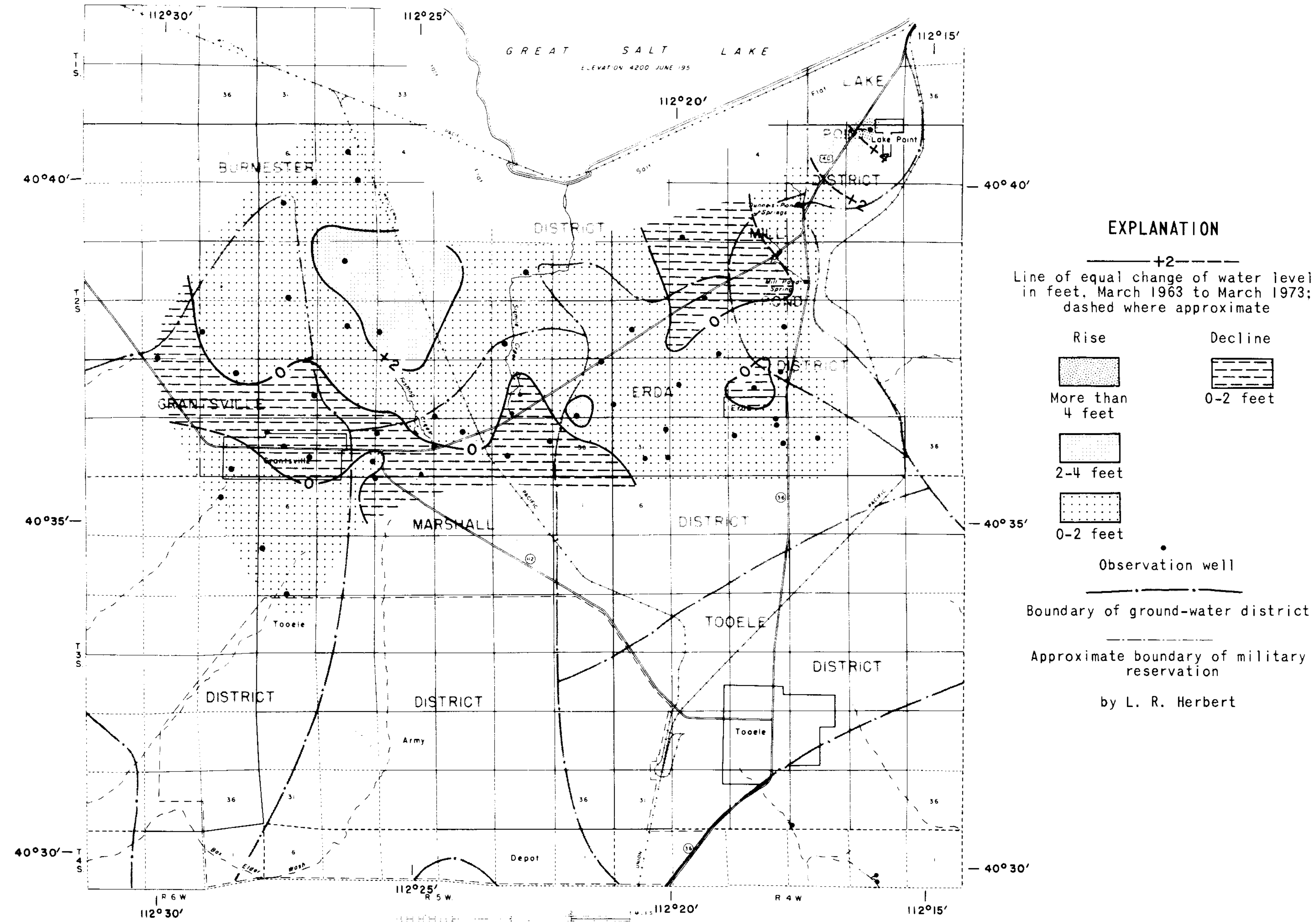
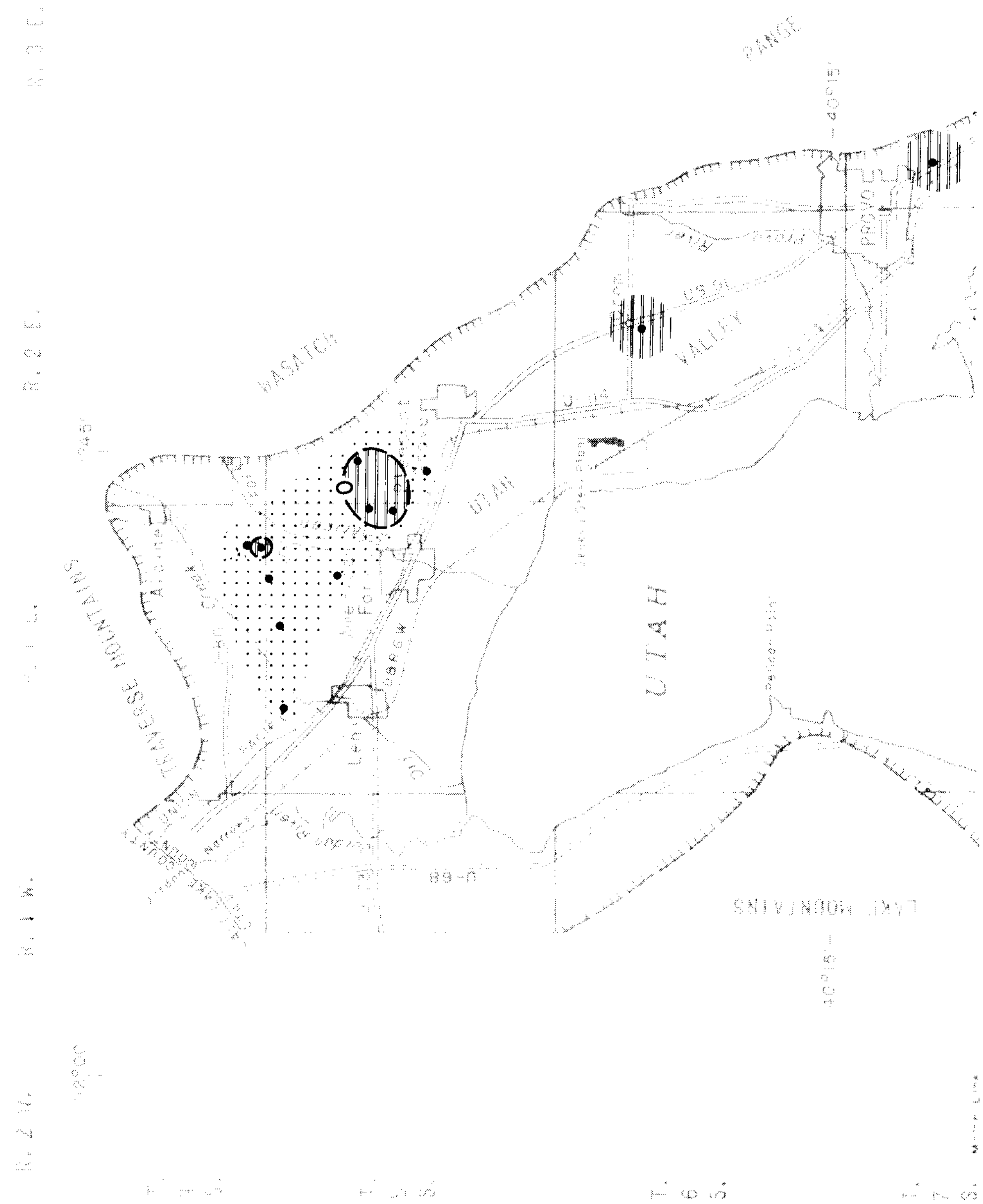


Figure 15.—Map of Tooele Valley showing change of water levels in artesian aquifers from March 1963 to March 1973.


WASATCH
RANGE
TRAVERSE MOUNTAINS
UTAH
VALLEY
PROVO
LAKE MOUNTAINS

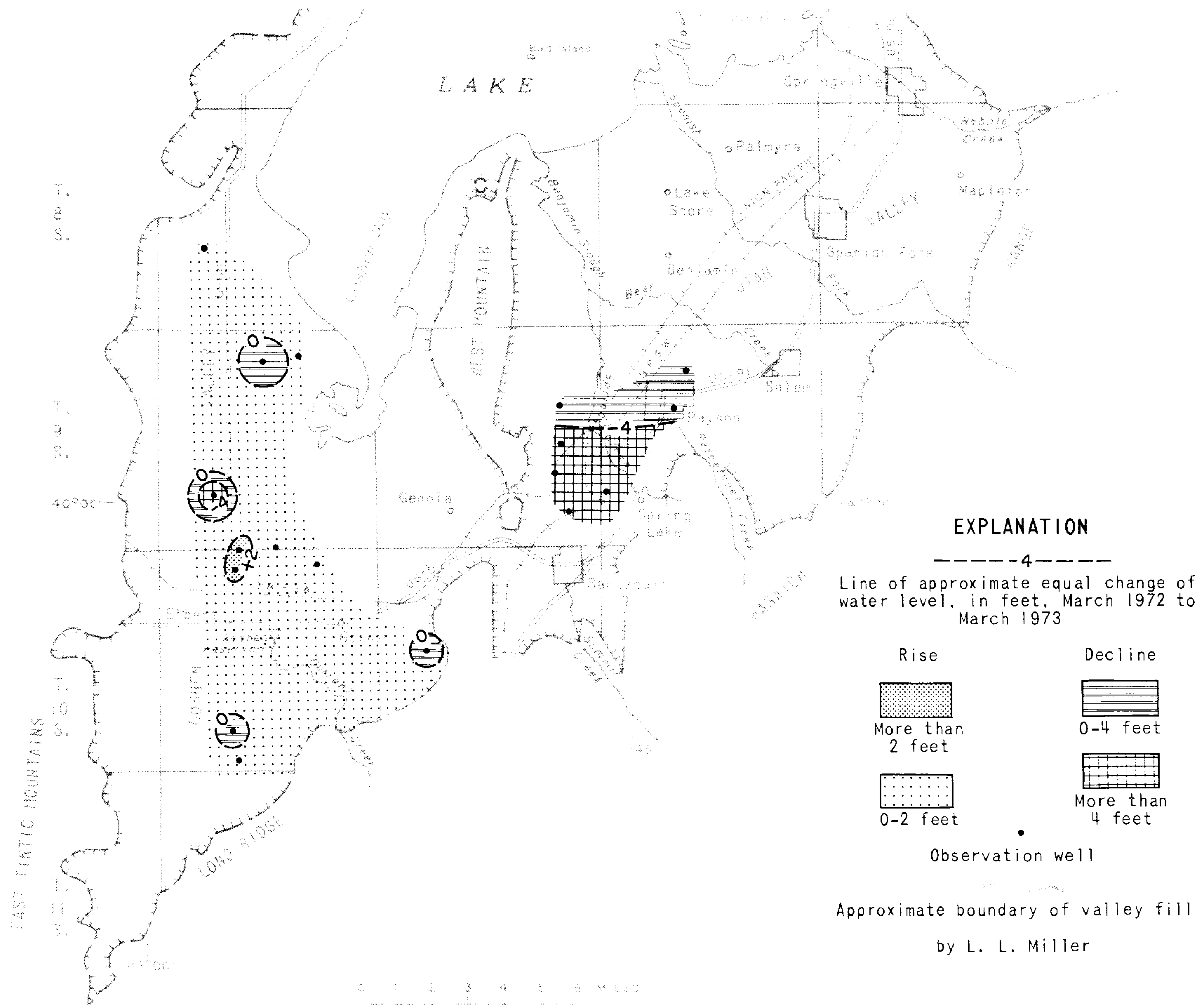
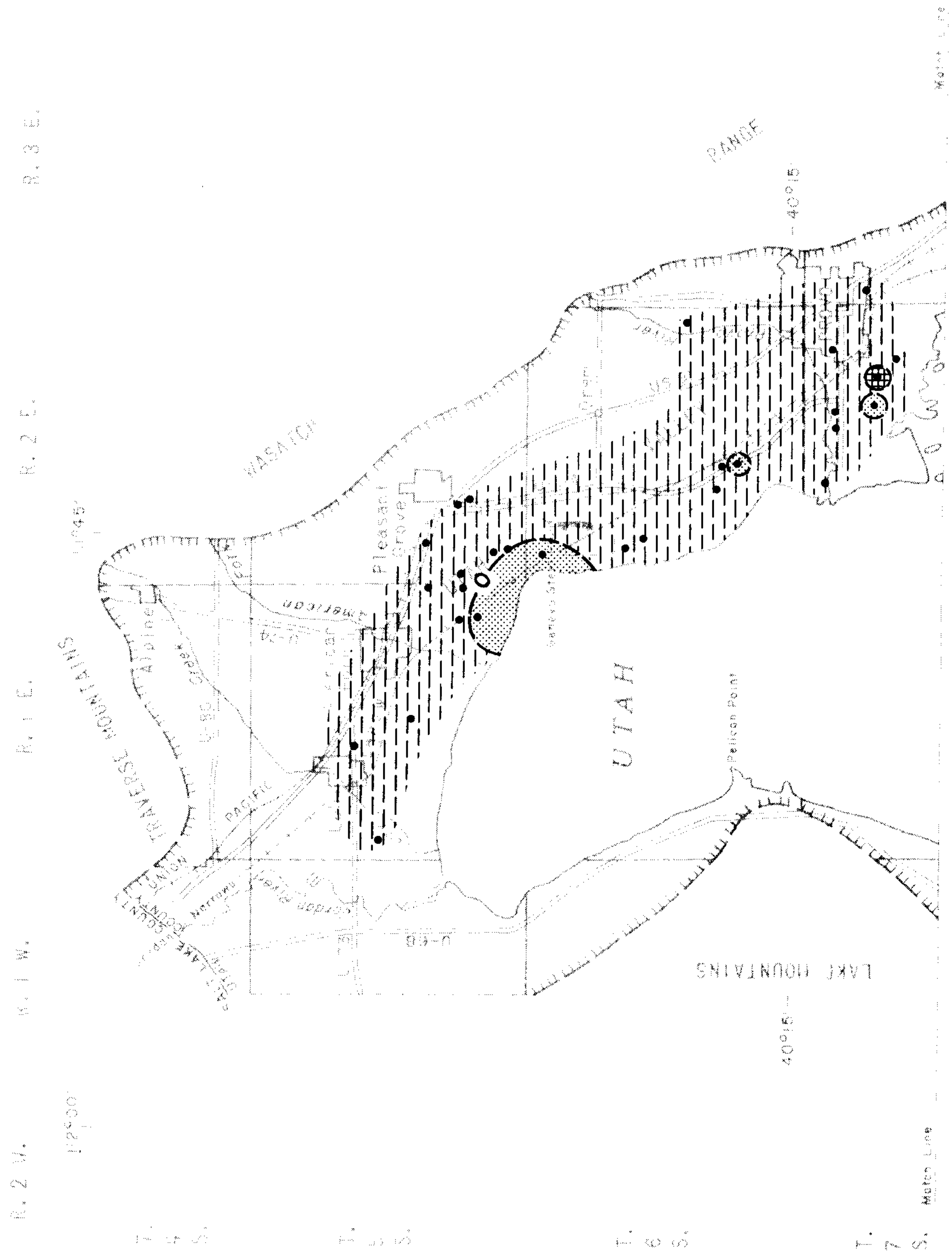


Figure 16.— Map of Utah and Goshen Valleys showing change of water levels in the water-table aquifers from March 1972 to March 1973.



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TRAVERSE MOUNTAINS
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Alpine
American
Pleasant Grove
UTAH
Pelican Point
LAKE MOUNTAINS
40°15'
Match Line

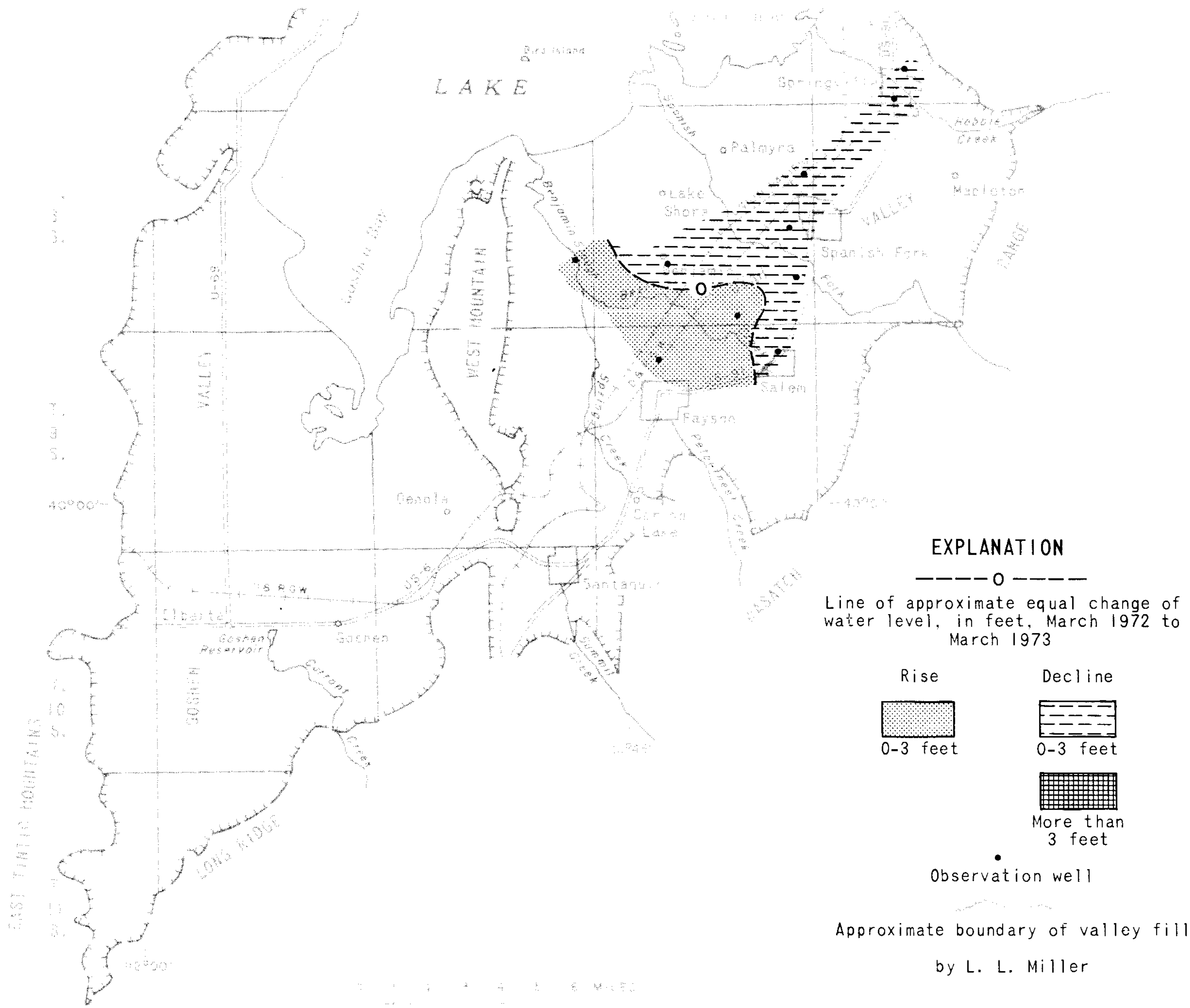
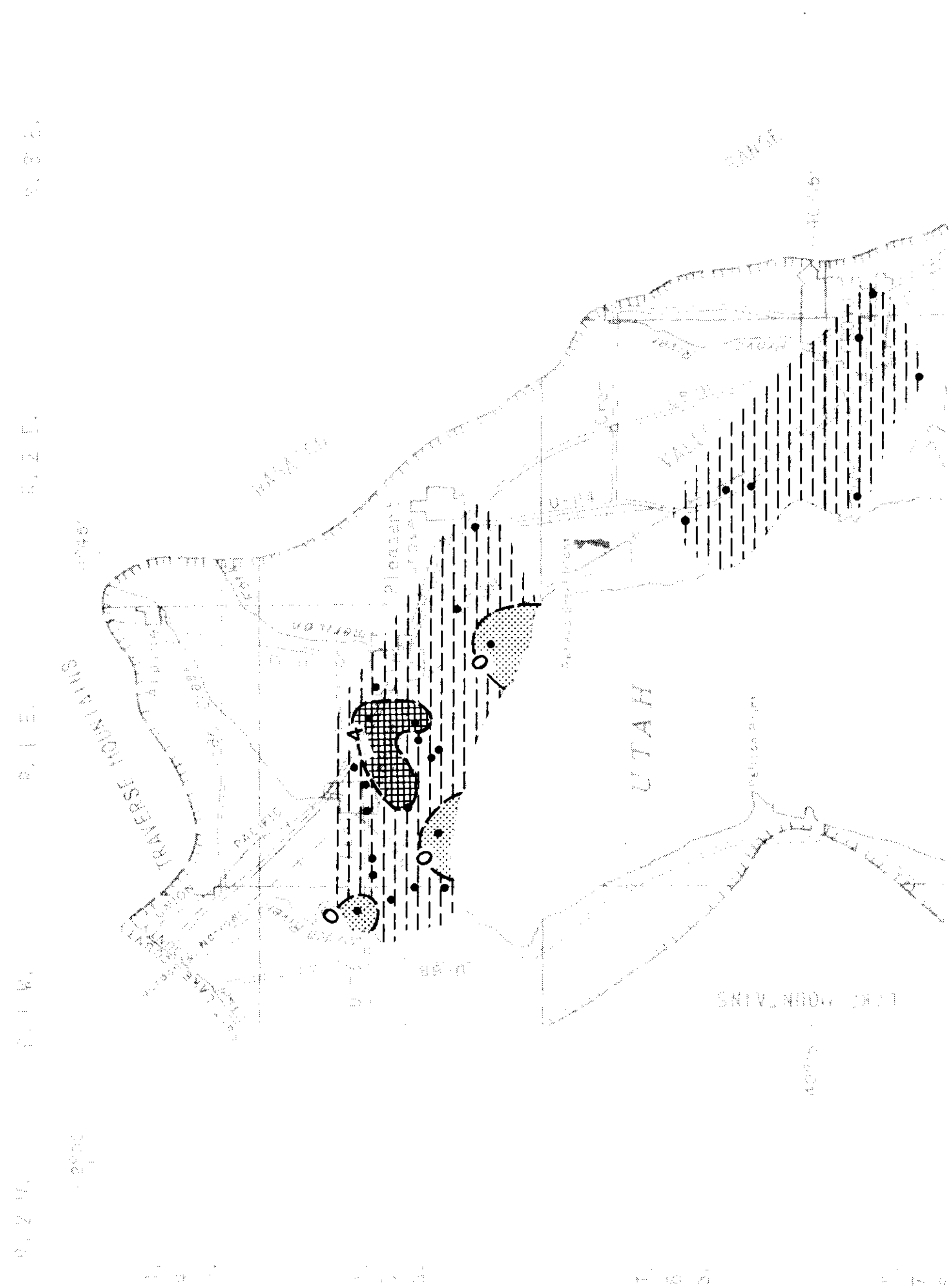


Figure 17.—Map of Utah and Goshen Valleys showing change of water levels in the shallow artesian aquifer in rocks of Pleistocene age from March 1972 to March 1973.


TRAVERSE MOUNTAINS
UTAH
LAKE MOUNTAINS
RANGE

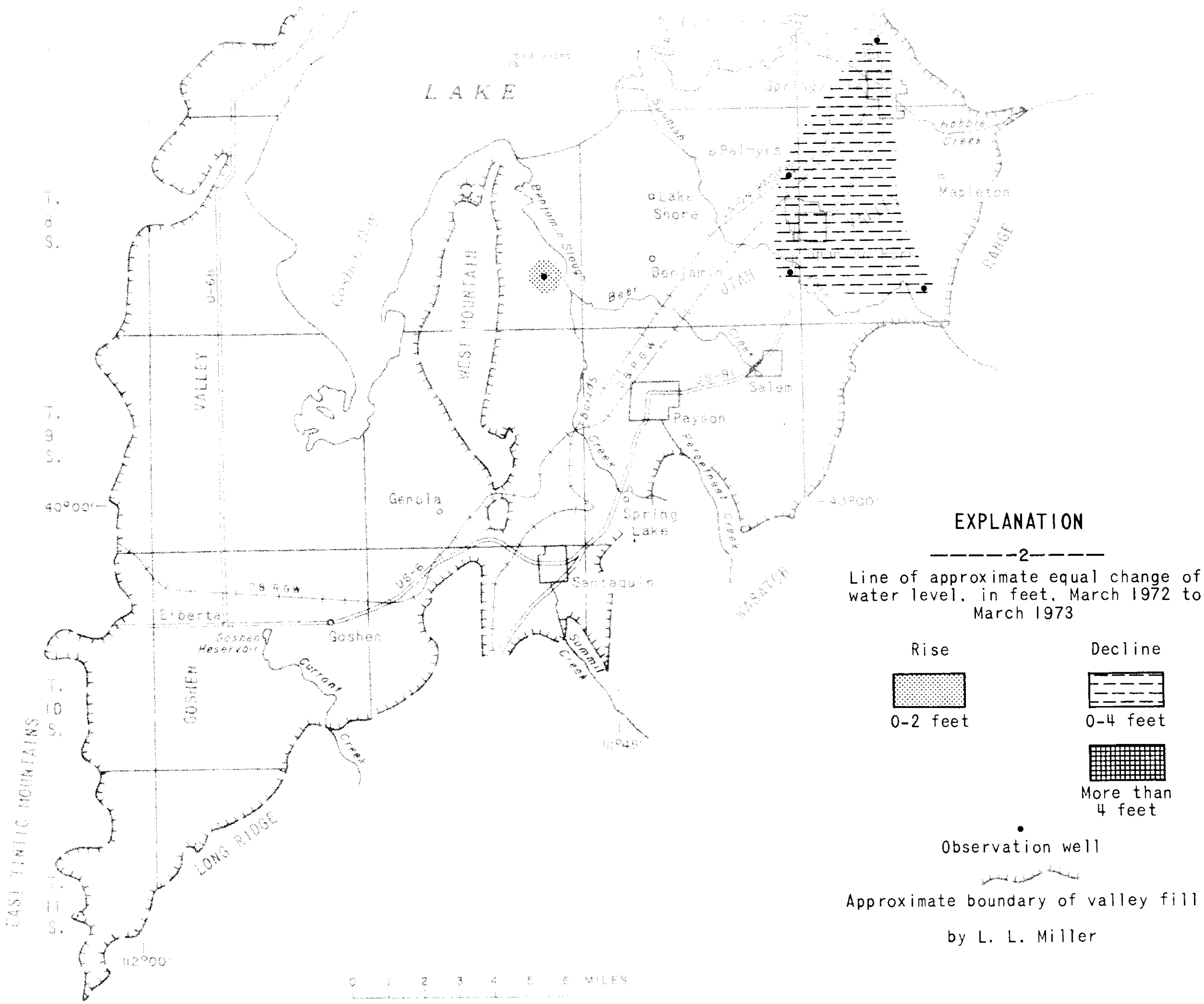
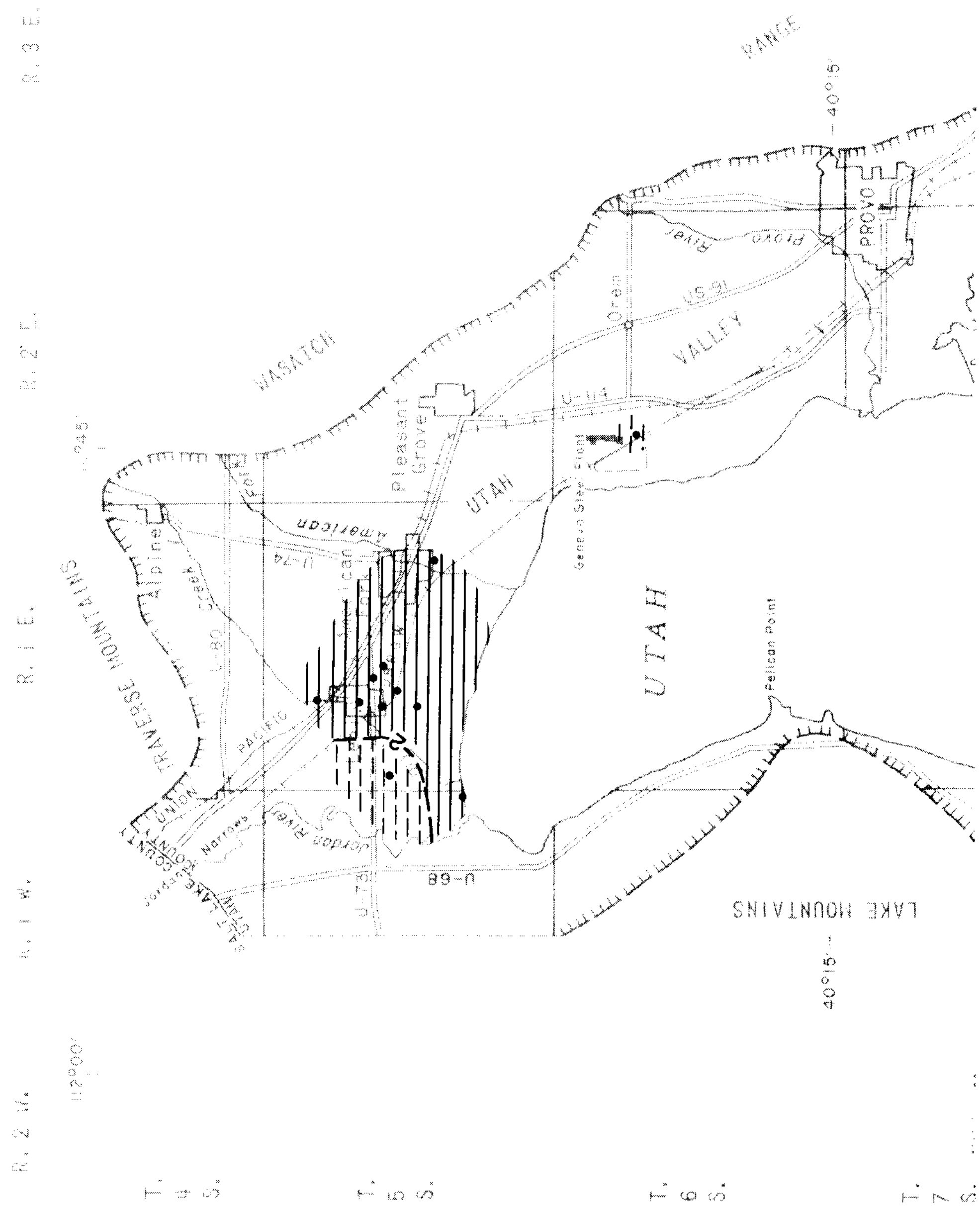


Figure 18.— Map of Utah and Goshen Valleys showing change of water levels in the deep artesian aquifer in rocks of Pleistocene age from March 1972 to March 1973.



WASATCH
RANGE
UTAH VALLEY
PROVO
Orem
Pleasant Grove
Alpine
TRAVERSE MOUNTAINS
UNION PACIFIC
U T A H
UTAH
LAKE MOUNTAINS
Pelican Point
Jordan River
Narrows
US-91
U-114
U-74
U-68
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R. 2 W.
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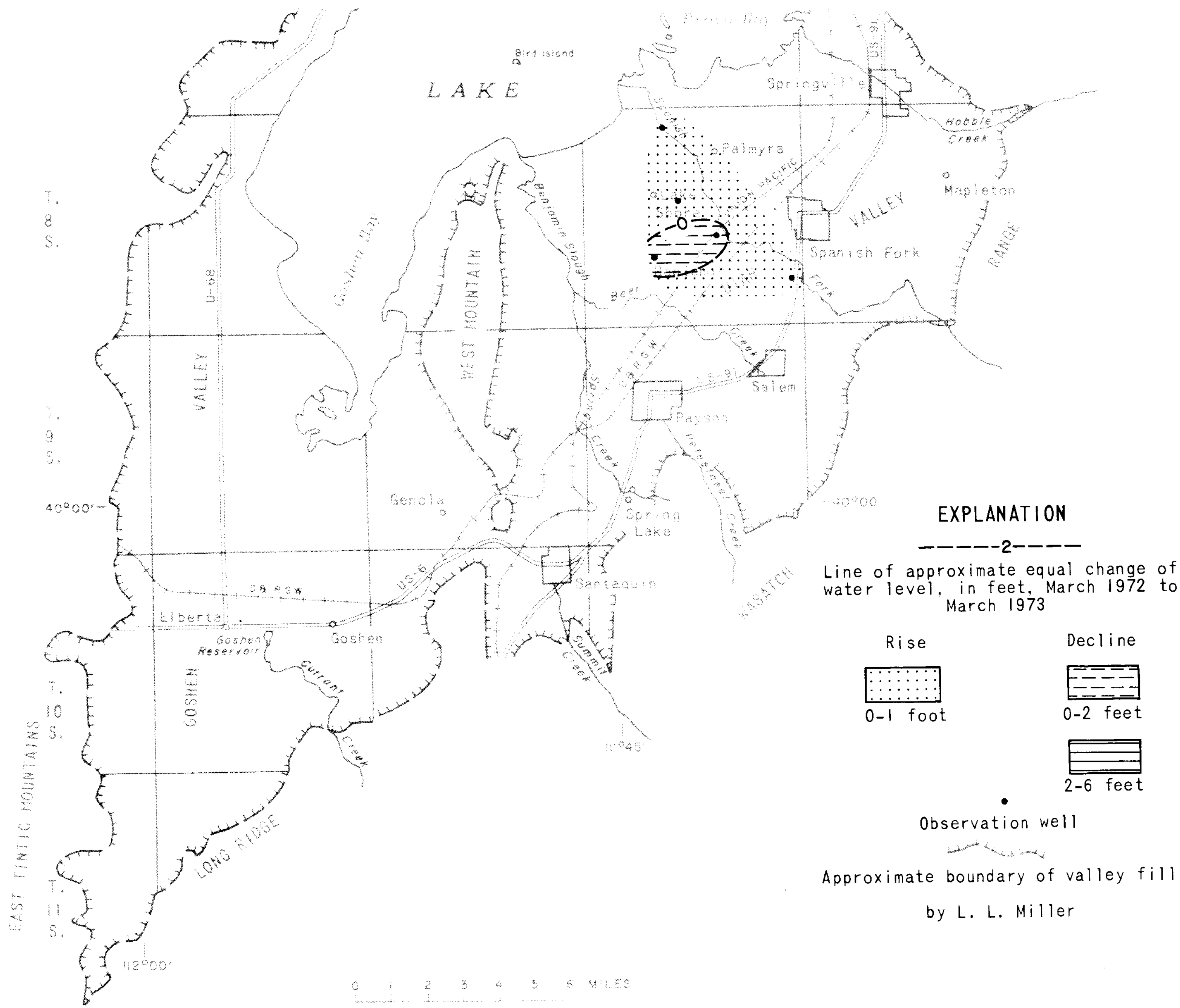


Figure 19.—Map of Utah and Goshen Valleys showing change of water levels in the artesian aquifer in rocks of Tertiary age from March 1972 to March 1973.

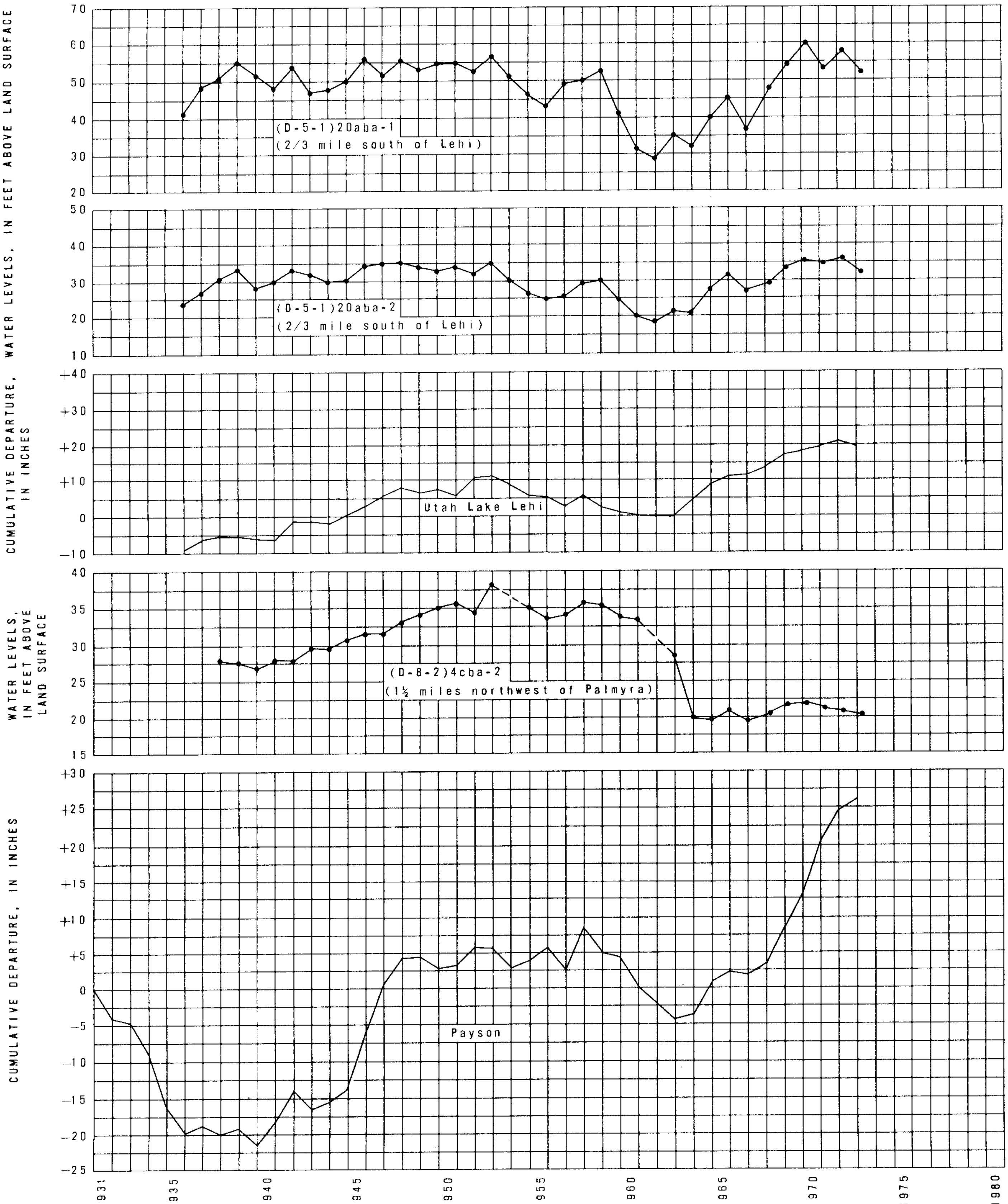
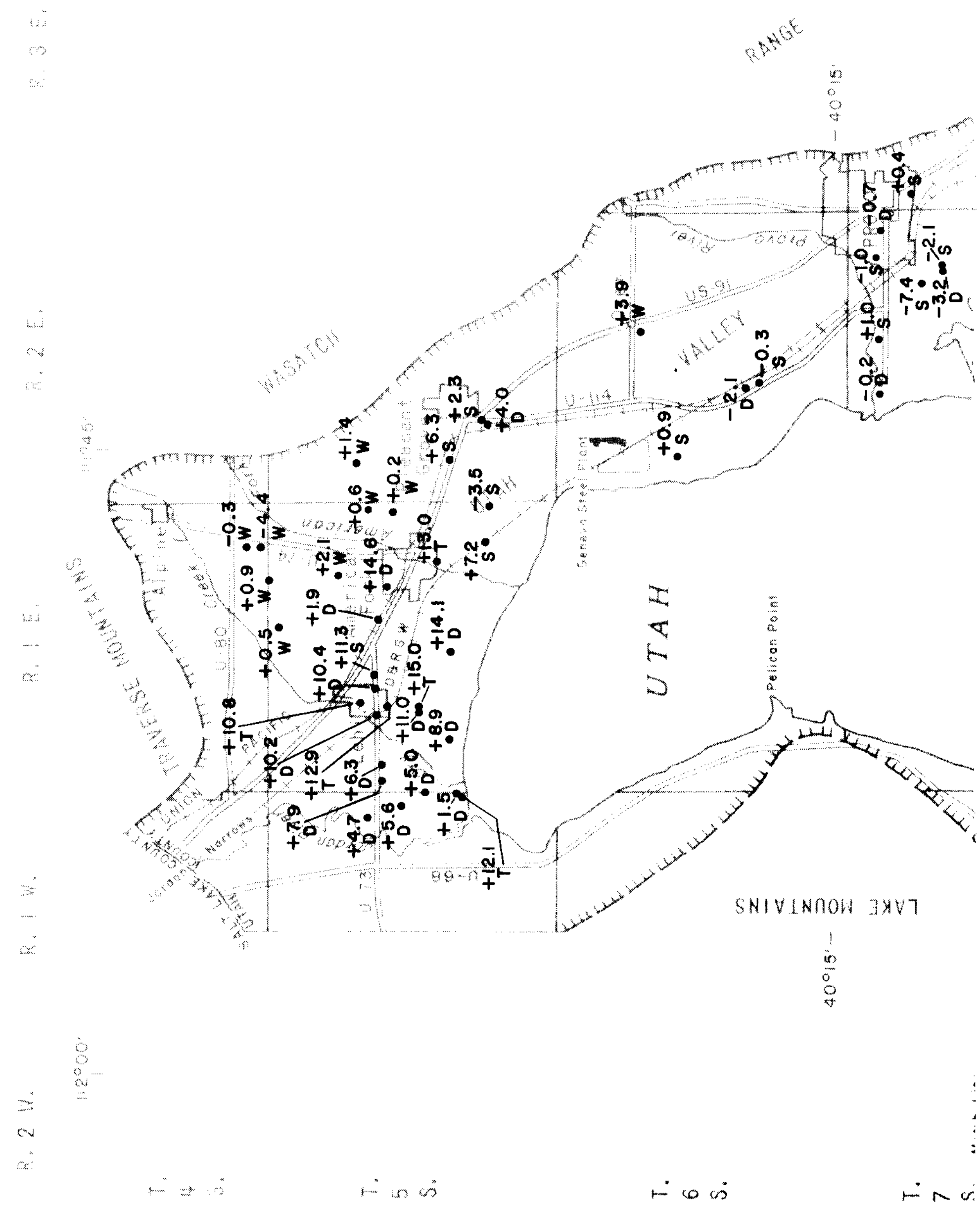


Figure 20.—Relation of water levels in selected observation wells in Utah Valley to cumulative departure from the 1931-60 normal annual precipitation at Utah Lake Lehi and Payson.



WASATCH
RANGE
VALLEY
TRAVERSE MOUNTAINS
LAKE MOUNTAINS
UTAH
Pelican Point

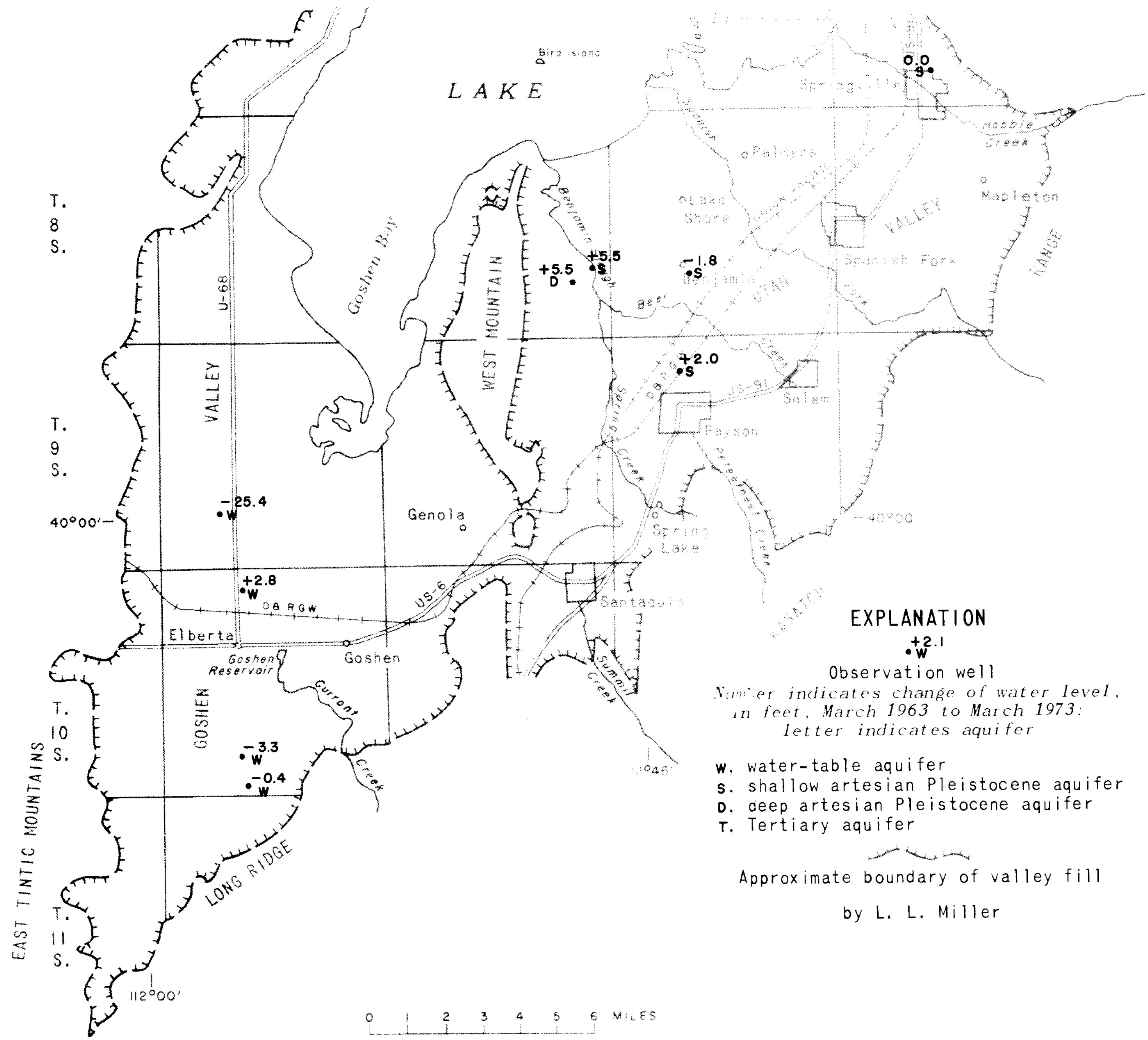
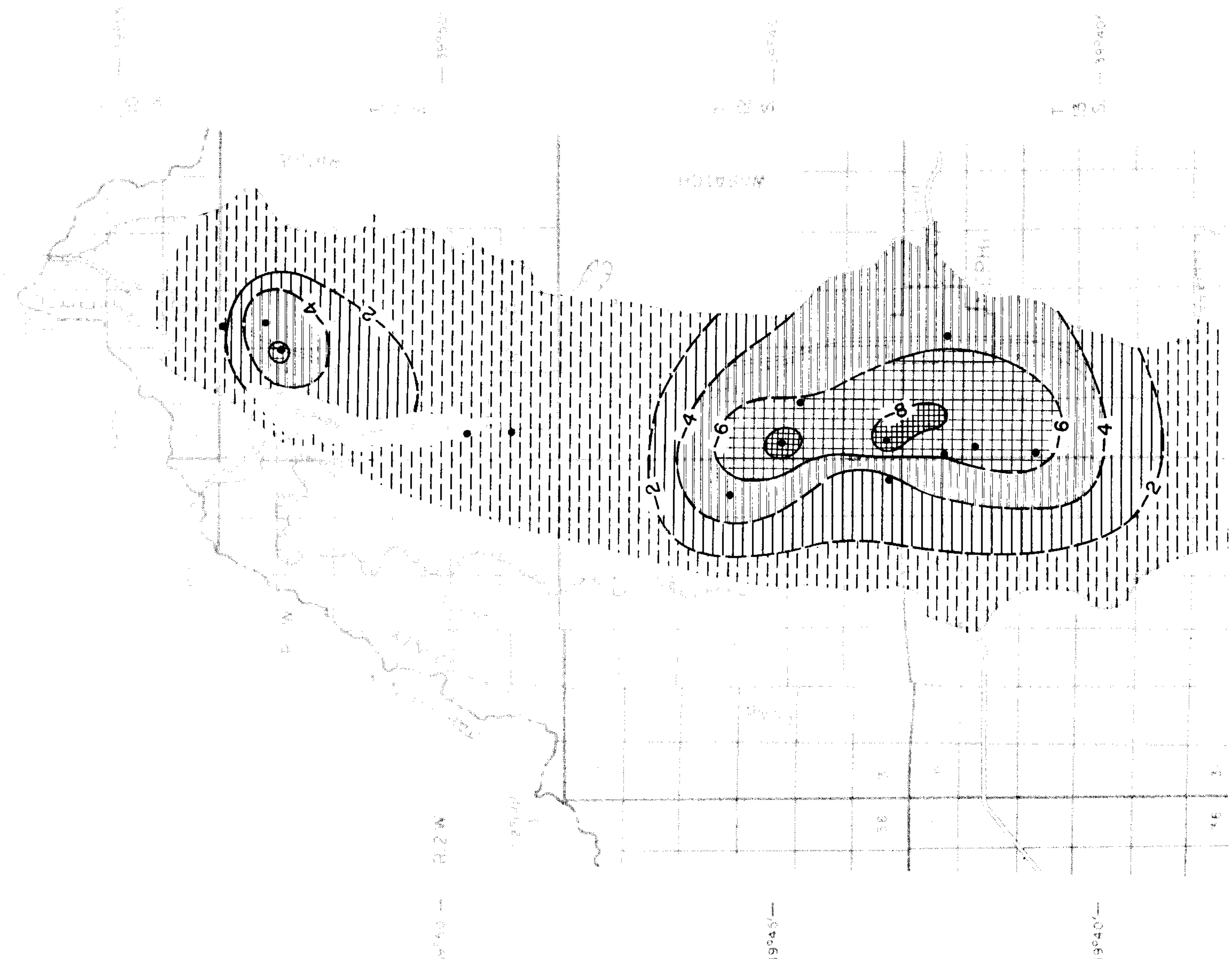


Figure 21.—Map of Utah and Goshen Valleys showing change of water levels from March 1963 to March 1973.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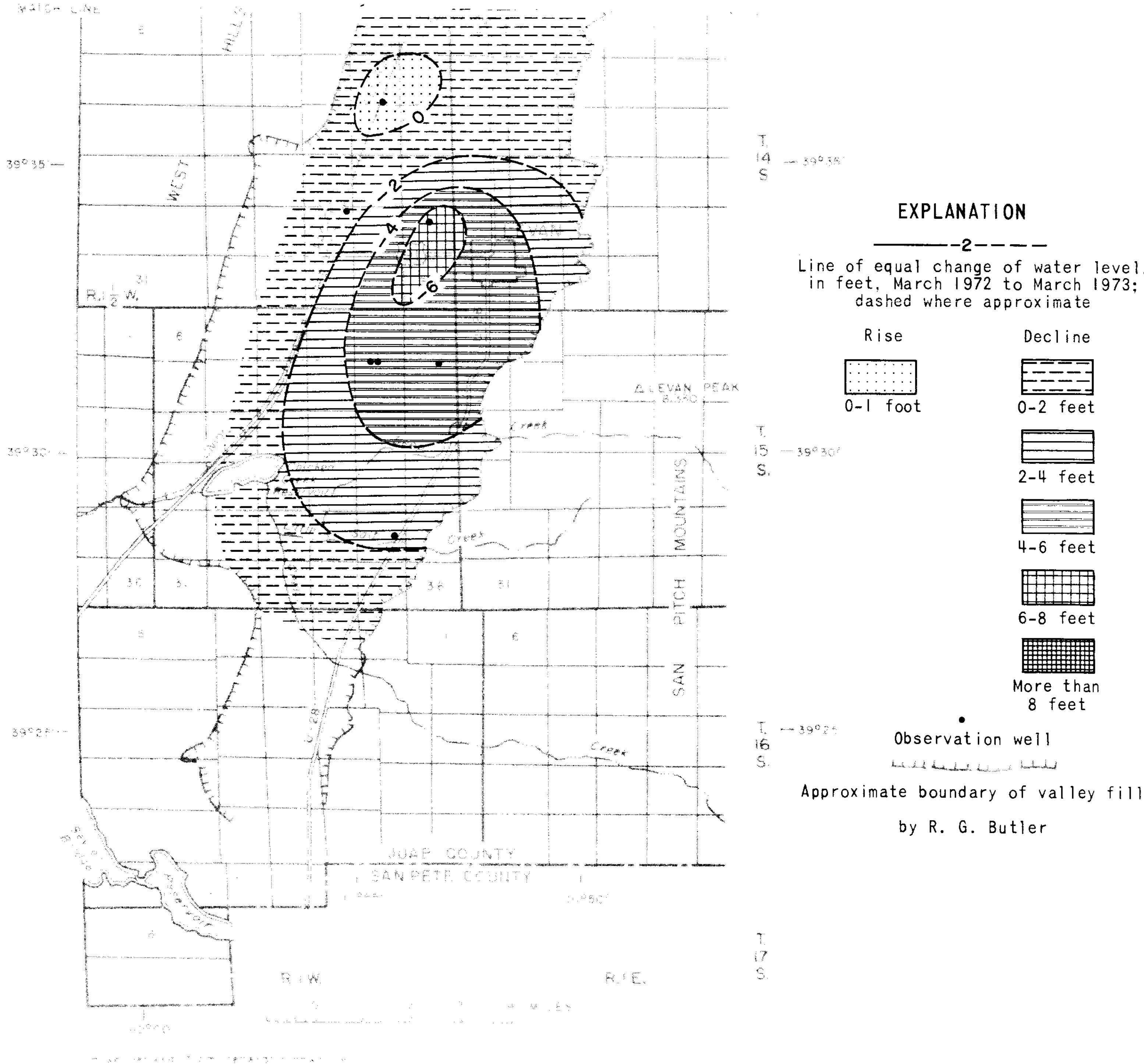


Figure 22.— Map of Juab Valley showing change of water levels from March 1972 to March 1973.

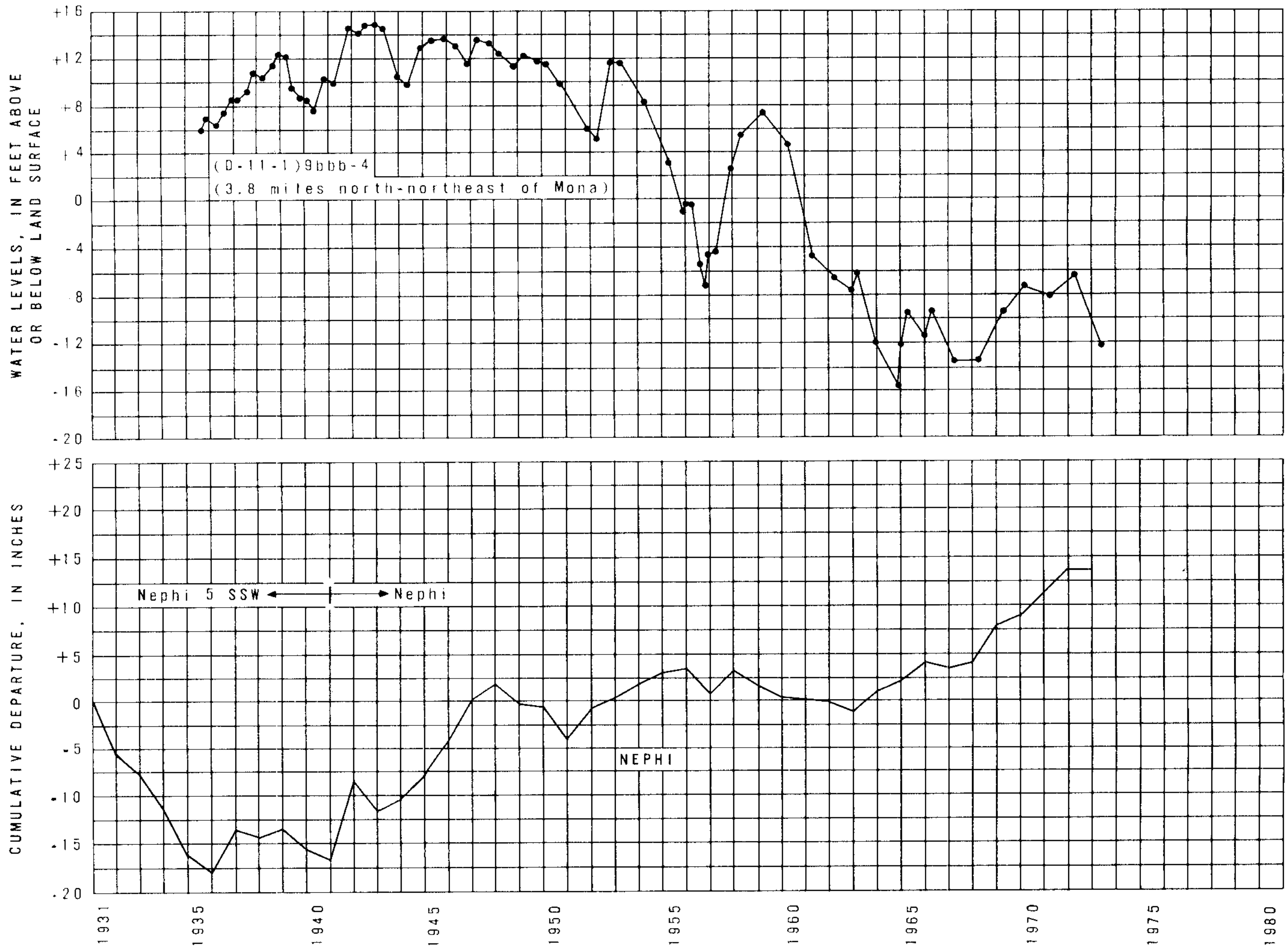


Figure 23.—Relation of water levels in selected wells to cumulative departure from the 1931-60 normal annual precipitation at Nephi and Levan.

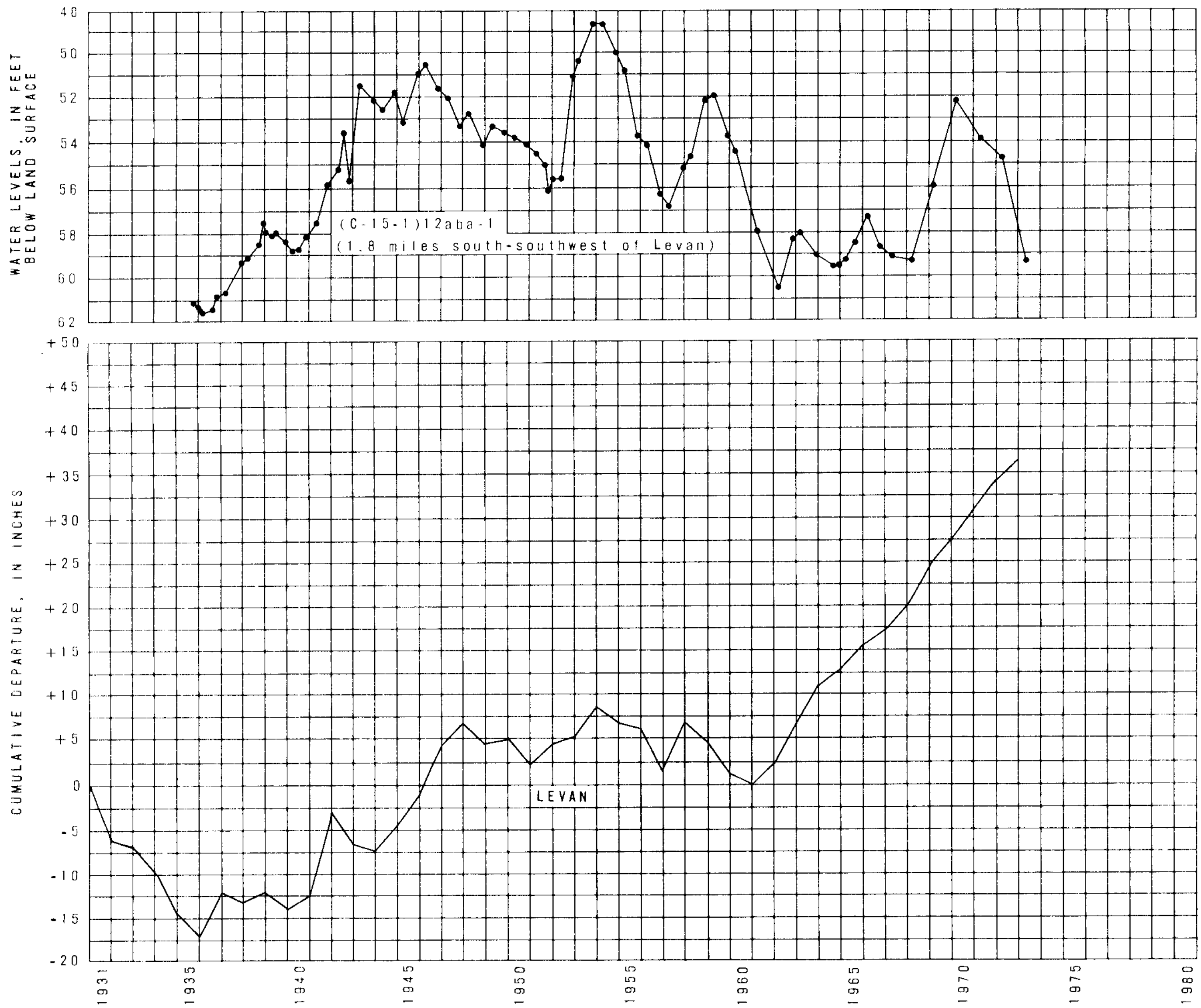
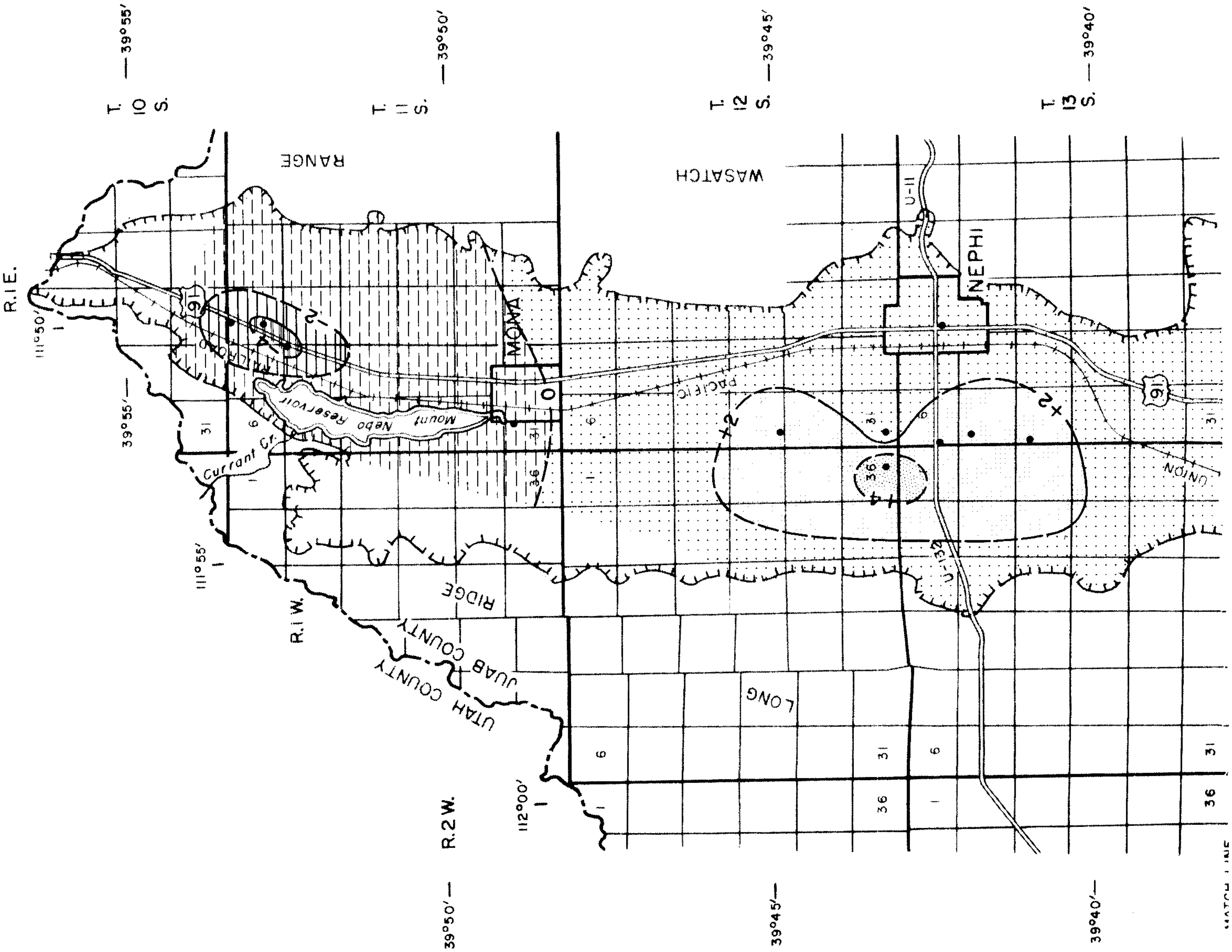


Figure 23.— Continued.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R.1 W.
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T. 13 S.
39°55'
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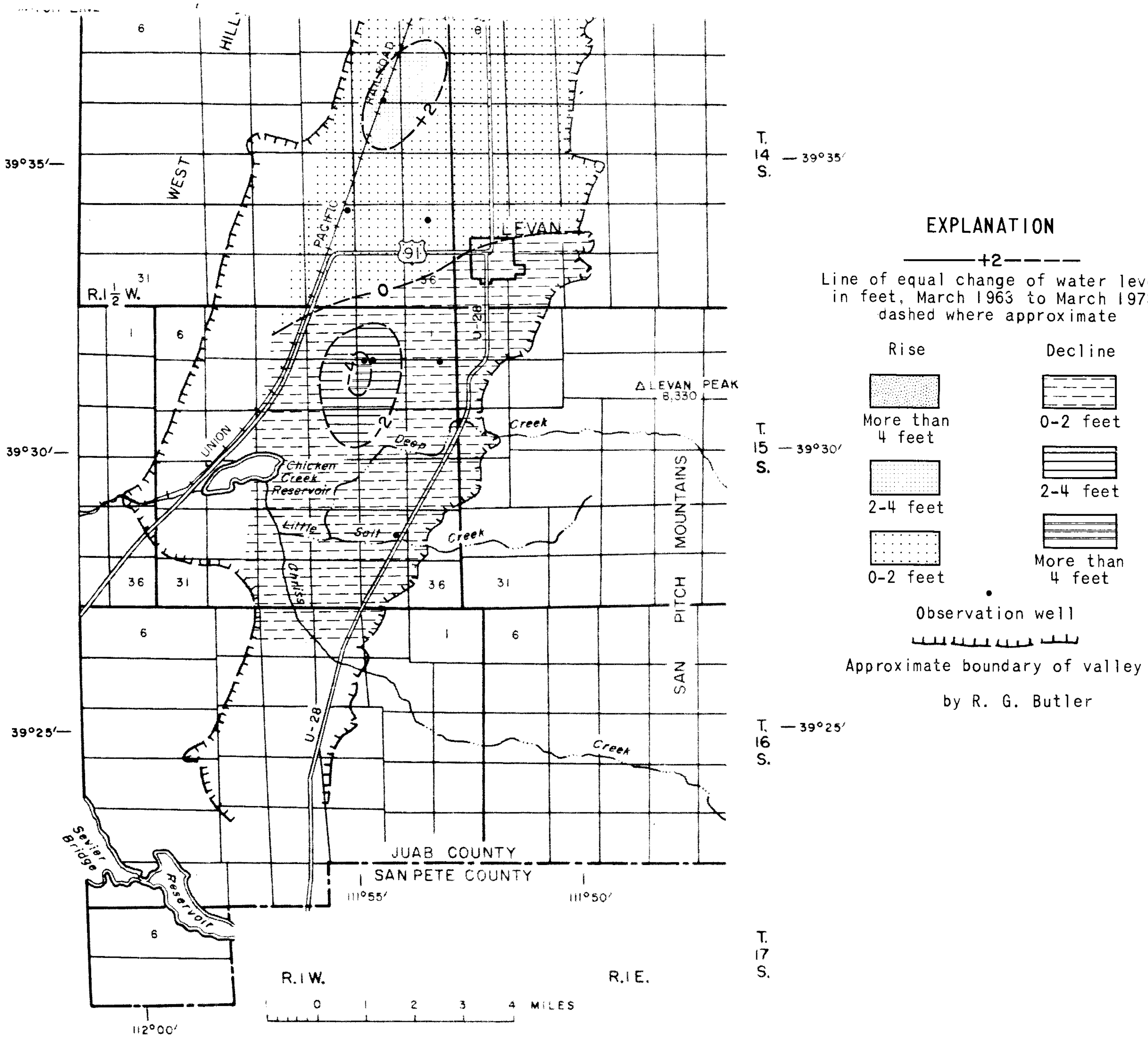
39°40'
111°50'
111°55'
112°00'
RANGE
WASATCH
LONG
RIDGE
NEPHI
MONA
Mount Nebo Reservoir
Currant Cr.
UTAH COUNTY
JUAB COUNTY
UNION
PACIFIC
U-11
U-132
91



Base derived from general highway map

Figure 24.— Map of Juab Valley showing change of water levels from March 1963 to March 1973.

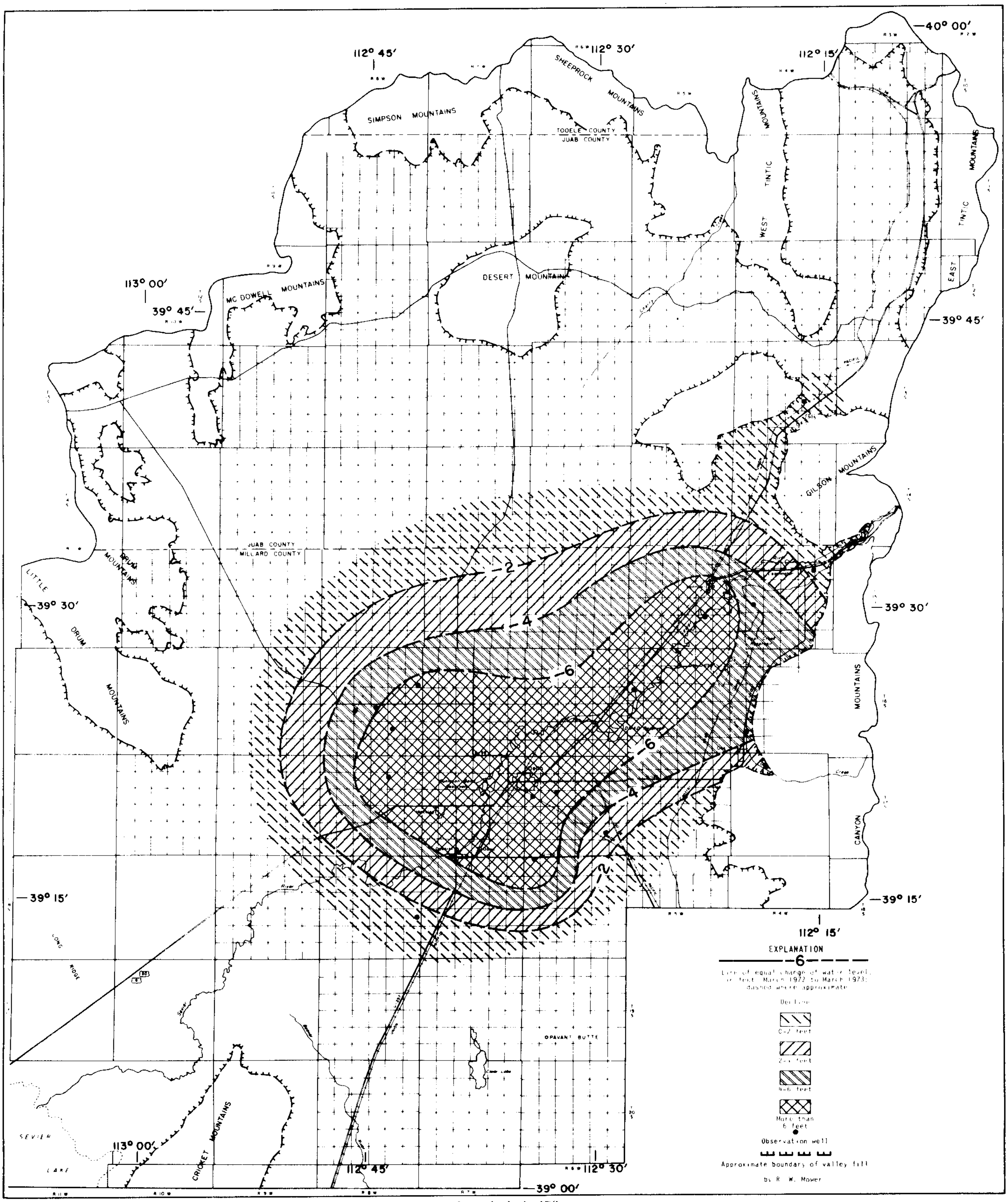


Figure 25.—Map of part of the Sevier Desert showing change of water levels in the lower artesian aquifer from March 1972 to March 1973.

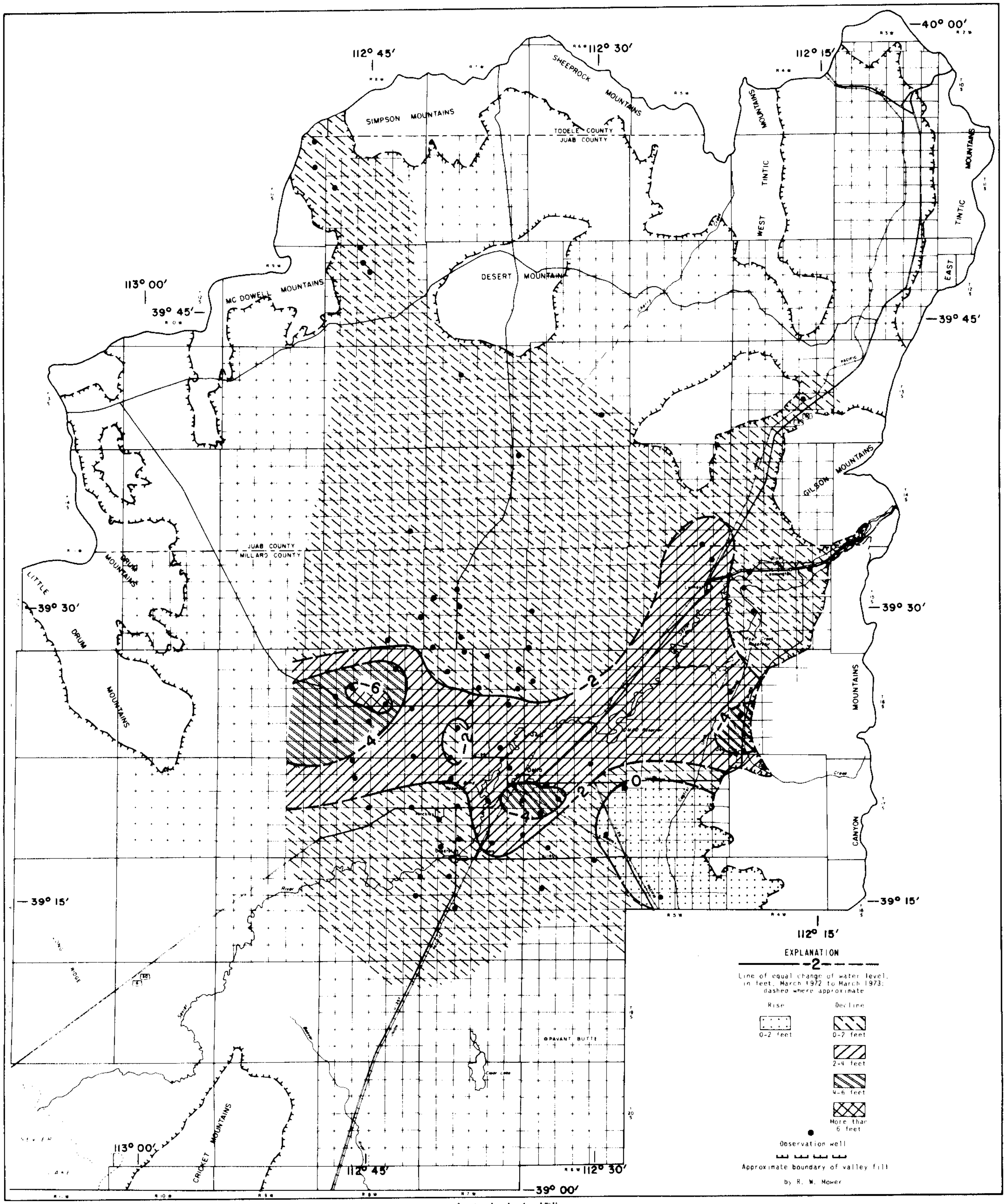


Figure 26.— Map of part of the Sevier Desert showing change of water levels in the upper artesian aquifer from March 1972 to March 1973.

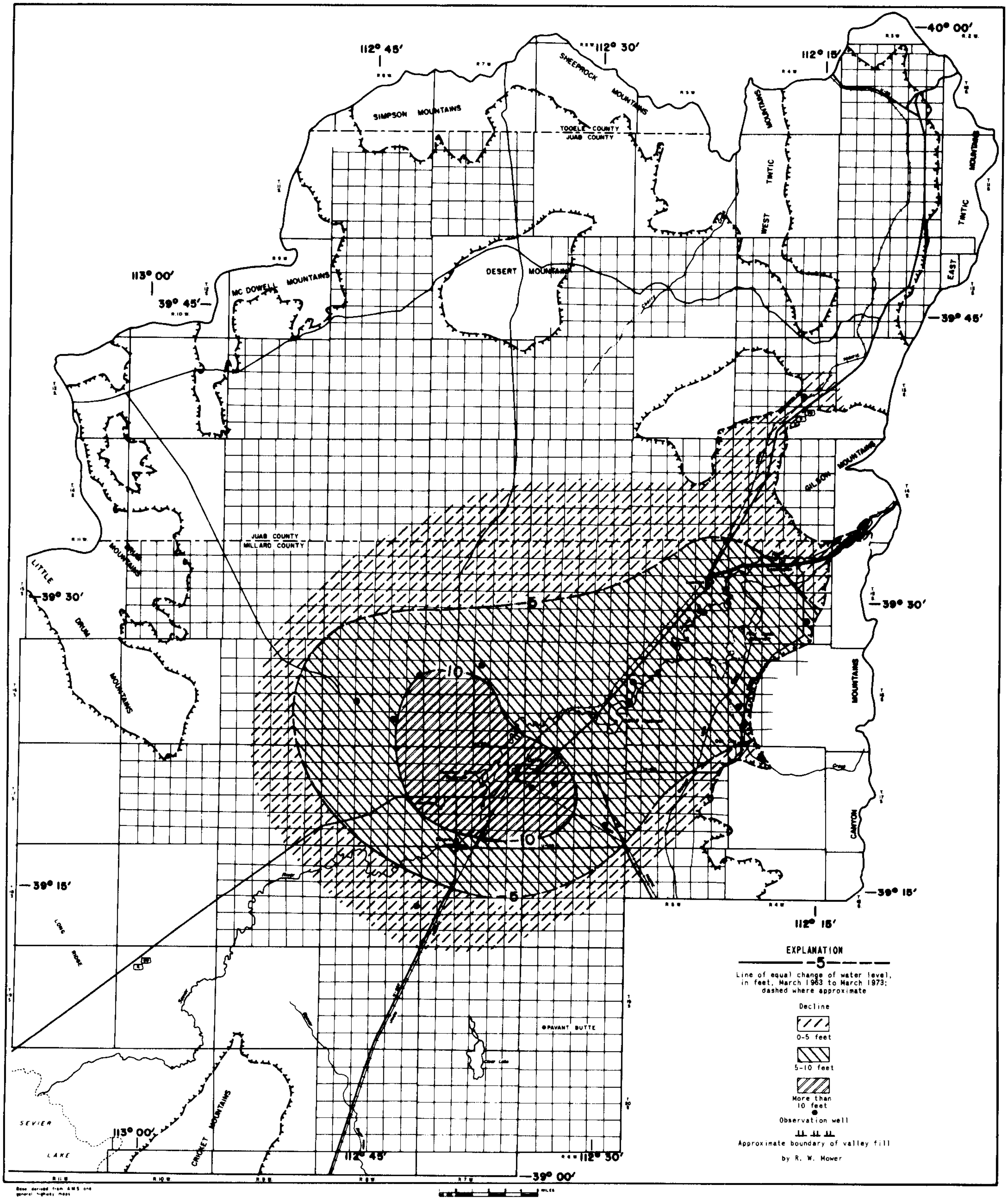


Figure 27.—Map of part of the Sevier Desert showing change of water levels in the lower artesian aquifer from March 1963 to March 1973.

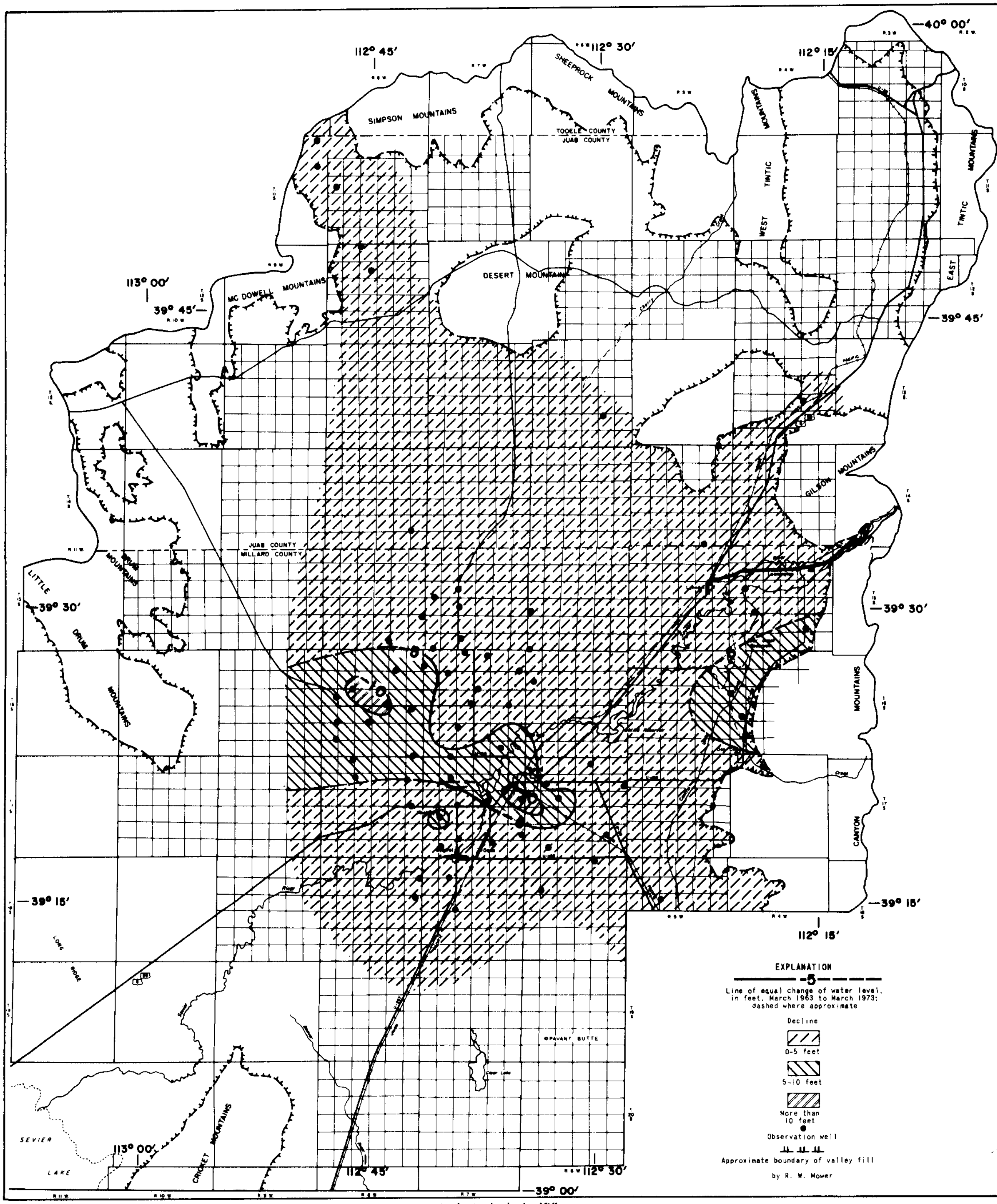


Figure 28.—Map of part of the Sevier Desert showing change of water levels in the upper artesian aquifer from March 1963 to March 1973.

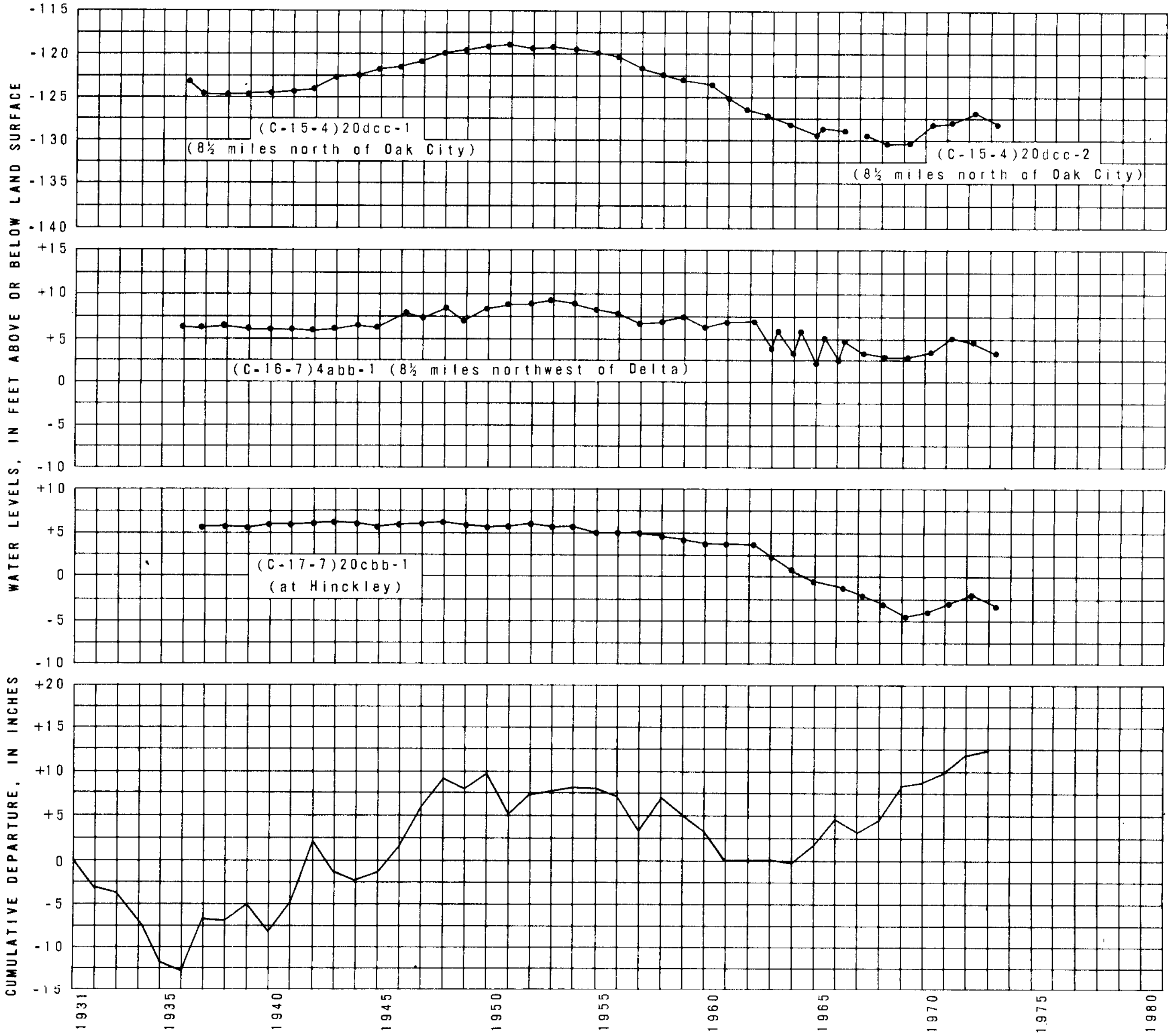


Figure 29.— Relation of water levels in selected wells in the Sevier Desert to cumulative departure from the 1931-60 normal annual precipitation at Oak City.

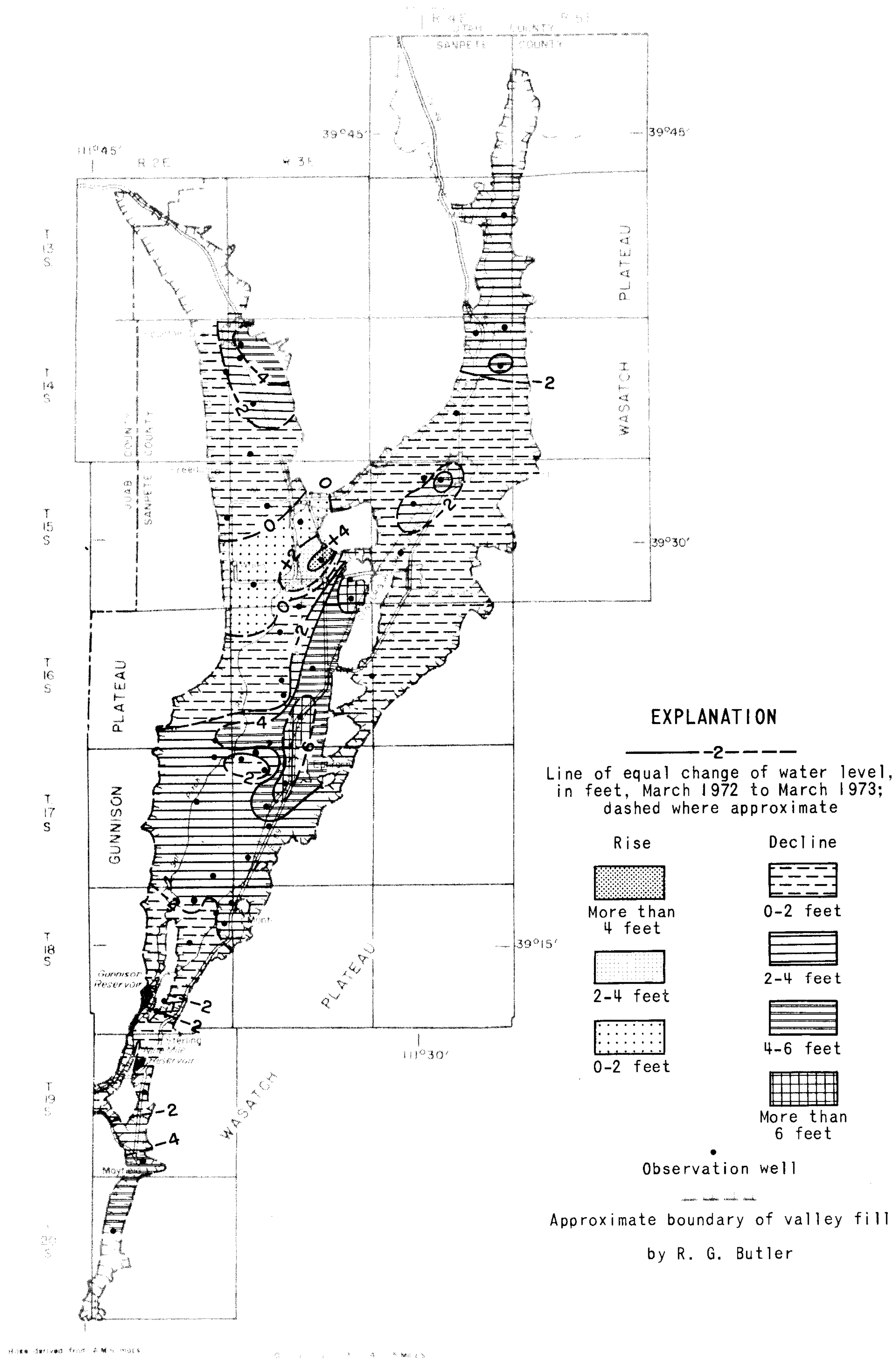


Figure 30.—Map of Sanpete Valley showing change of water levels from March 1972 to March 1973.

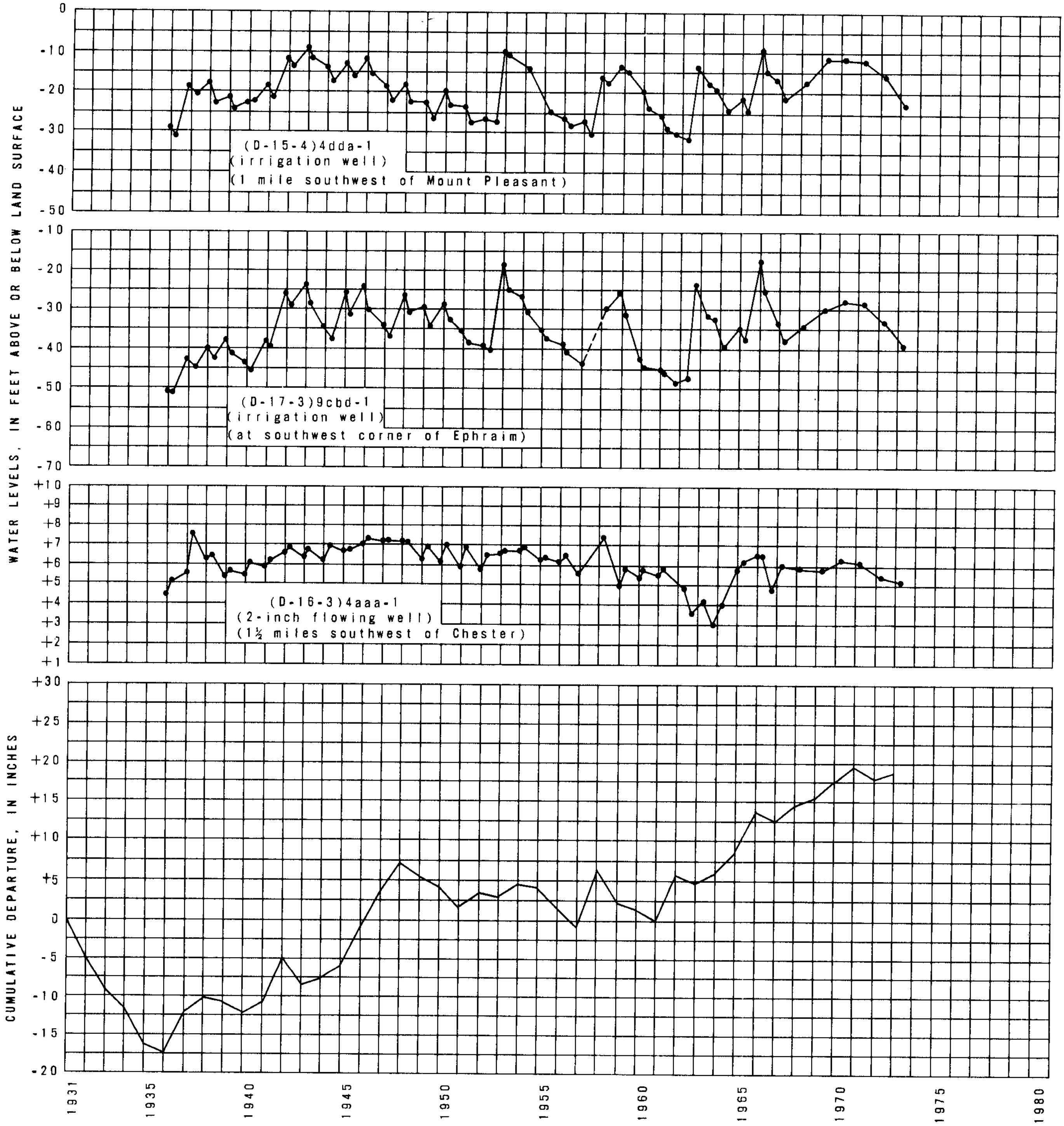


Figure 31.—Relation of water levels in selected wells in Sanpete Valley to cumulative departure from the 1931-60 normal annual precipitation at Manti.

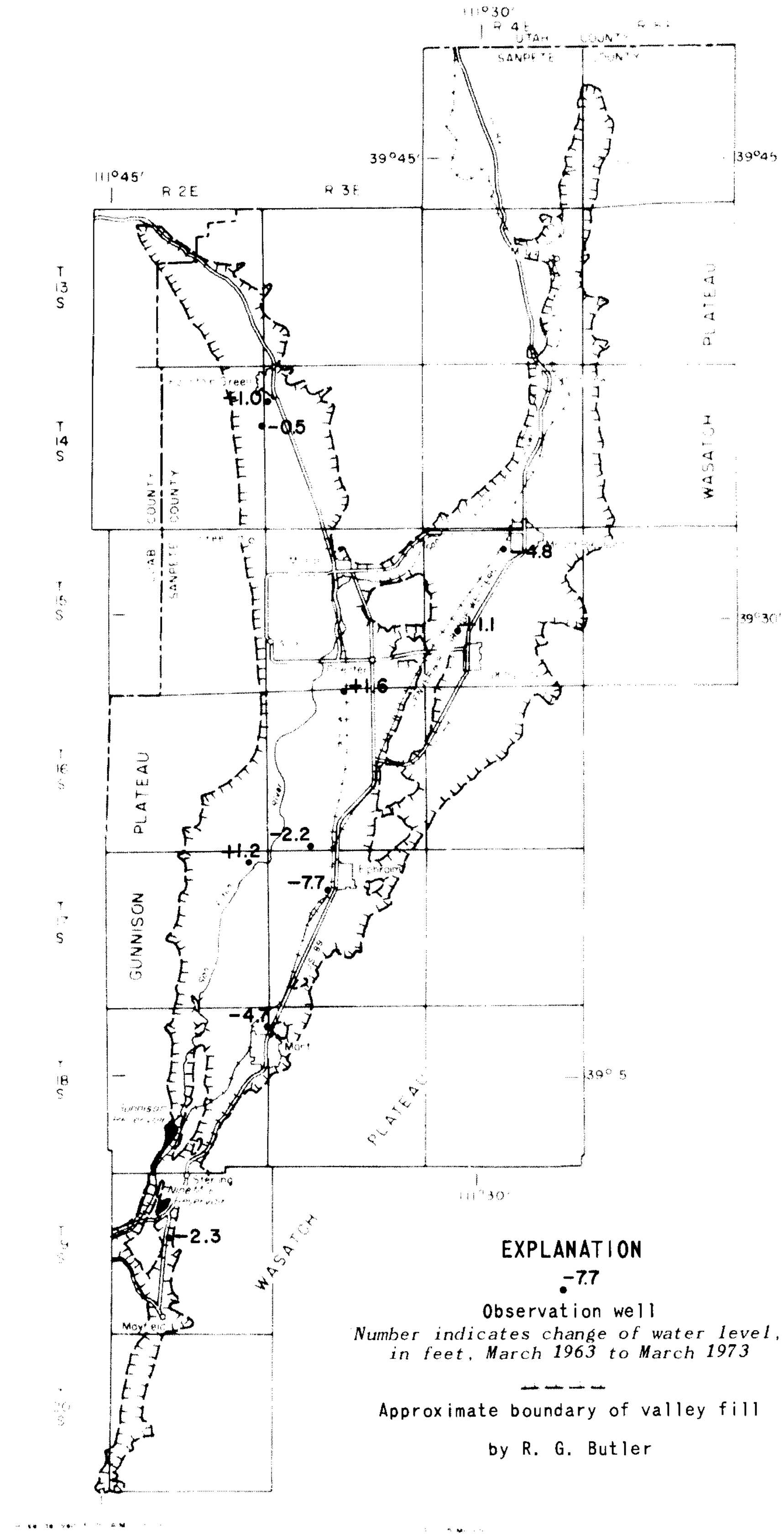


Figure 32.—Map of Sanpete Valley showing change of water levels from March 1963 to March 1973.

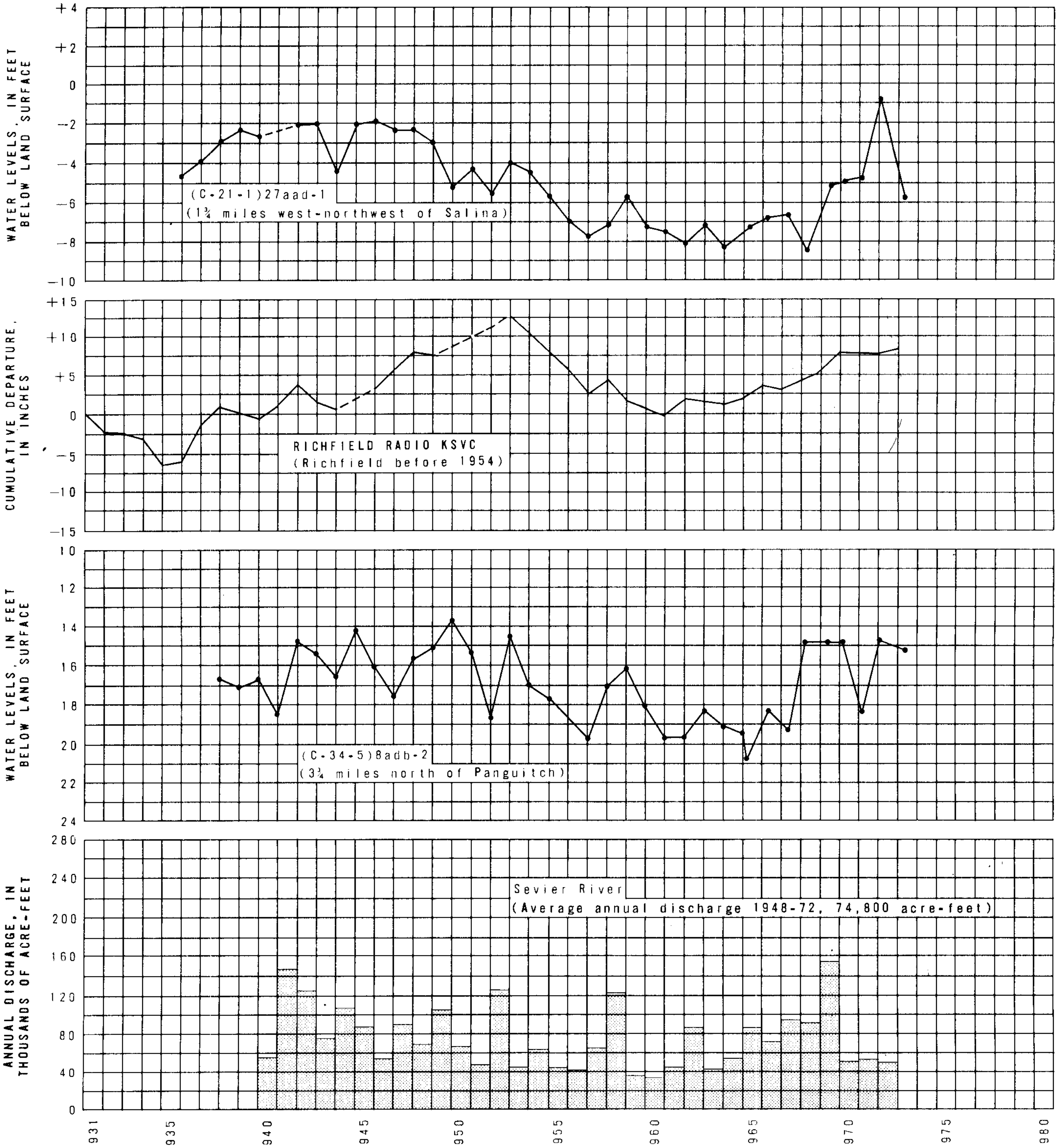


Figure 33.— Relation of water levels in selected wells and of average annual discharge of the Sevier River at Hatch to cumulative departure from the 1931-60 normal annual precipitation at Richfield Radio KSVC and Panguitch.

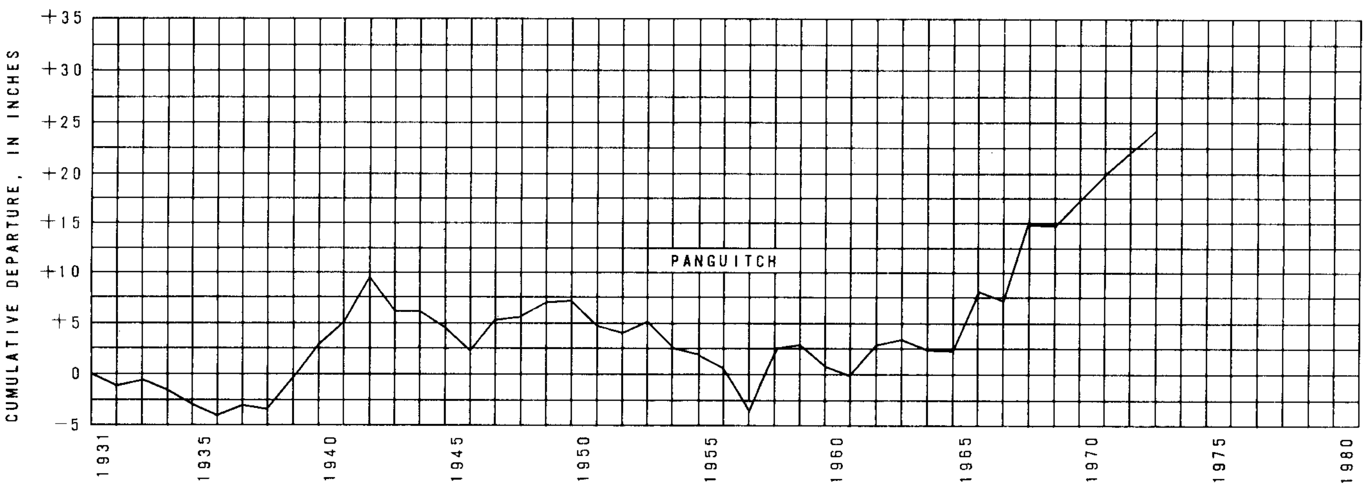
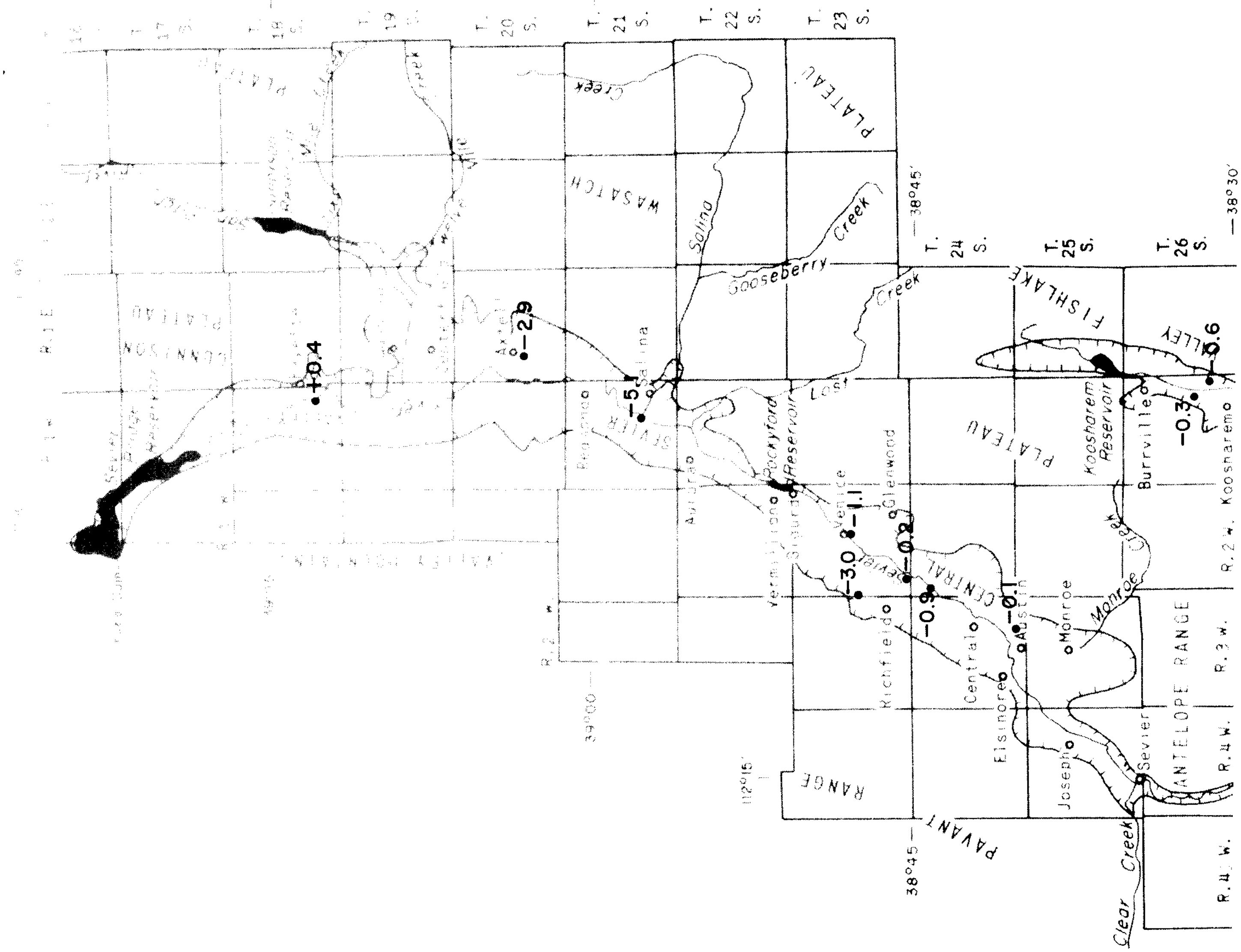


Figure 33.— Continued.



WASATCH
PLATEAU
GUNNISON
PLATEAU
FISHLAKE
PLATEAU
VALLEY
CENTRAL
ANTELOPE RANGE
PAVANT
RANGE
Salina
Gooseberry Creek
Lost Creek
Creek
SEVIER
Sevier
Koosharem Reservoir
Burrville
Koosharem
Rockyford Reservoir
Glenwood
Venice
Sigurd
Vermillion
Richfield
Austin
Monroe
Monroe Creek
Centralo
Elsinore
Joseph
Clear Creek
Redmond
Aurora
Axtell
+0.4
-2.9
-5.5
-1.1
-3.0
-0.8
-0.9
-0.1
-0.3
T. 17 S.
T. 18 S.
T. 19 S.
T. 20 S.
T. 21 S.
T. 22 S.
T. 23 S.
T. 24 S.
T. 25 S.
T. 26 S.
R. 1 E.
R. 2 W.
R. 3 W.
R. 4 W.
39°00'
38°45'
38°30'
112°15'

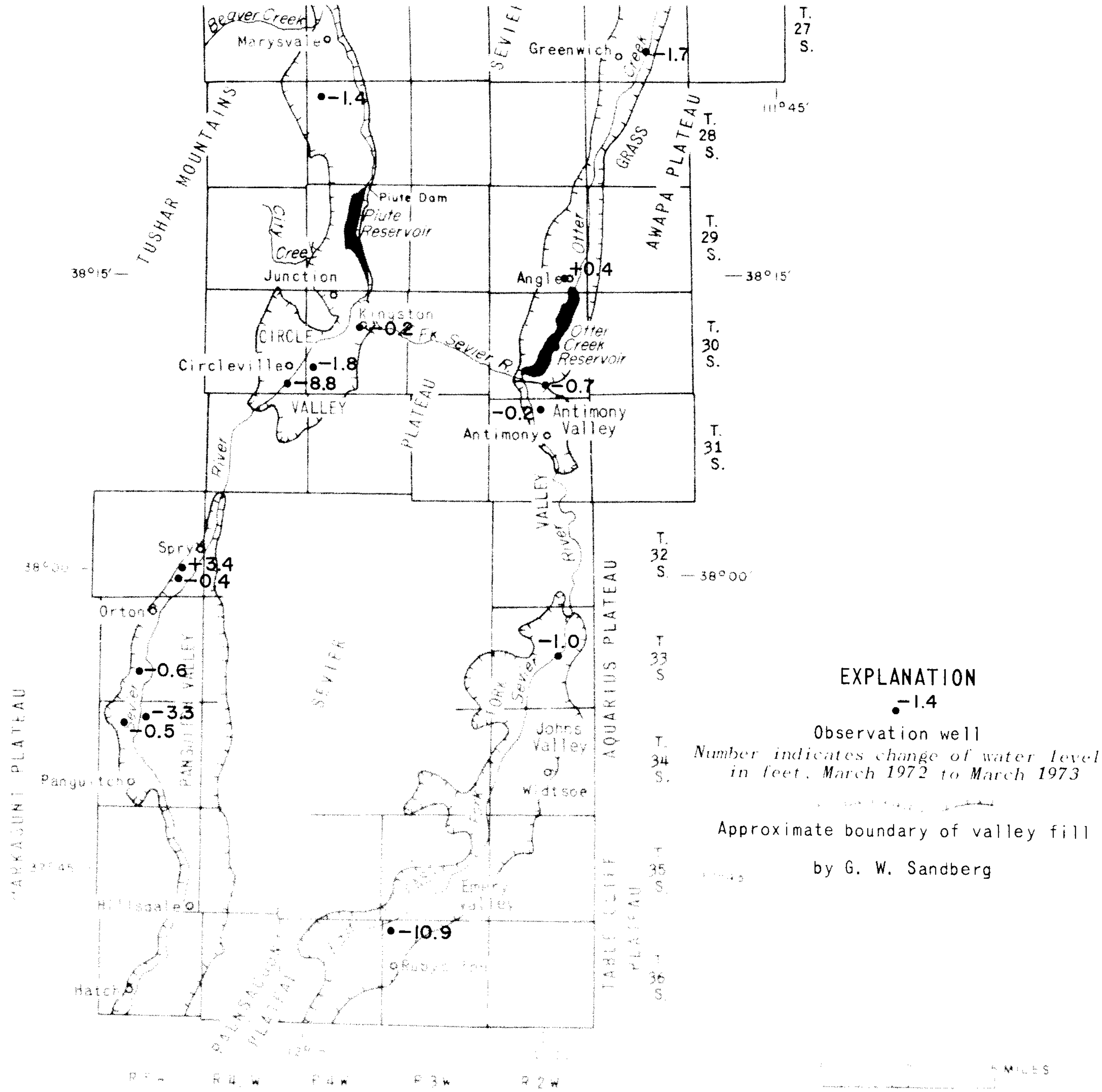
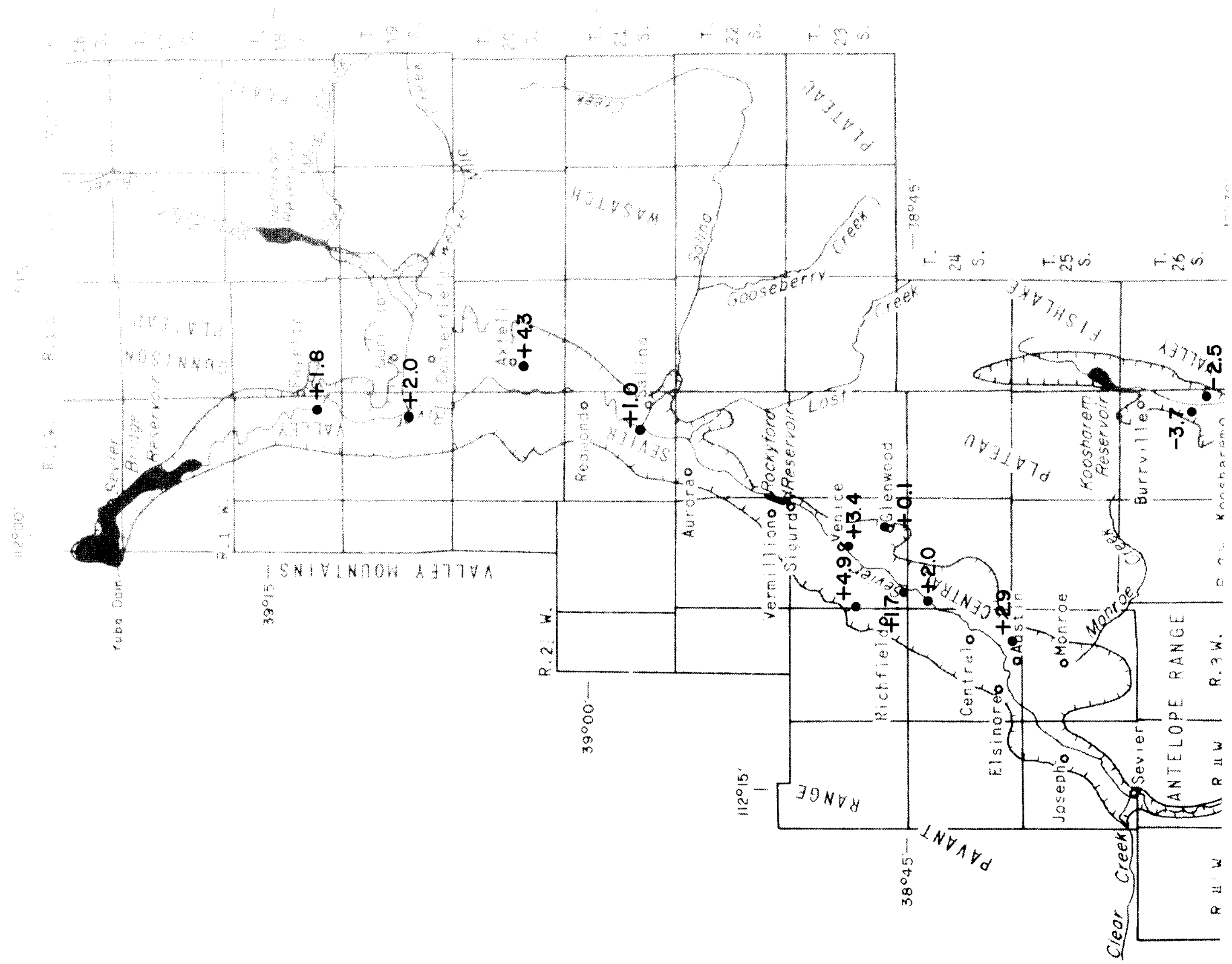


Figure 34.— Map of the upper and central Sevier Valleys showing change of water levels from March 1972 to March 1973.


Sevier Bridge Reservoir
Yuba Dam
VALLEY MOUNTAINS
GUNNISON PLATEAU
Fayette
Gunnison
Centerfield
Axtell
Salina
Redmond
SEVIER
RIVER
VALLEY
WASATCH
PLATEAU
Salina
Gooseberry Creek
Lost Creek
Aurora
Rockyford Reservoir
Vermillion
Sigurd
Venice
Glenwood
Richfield
Central
Elsinore
Joseph
Sevier
Austin
Monroe
Monroe Creek
CENTRAL
FISHLAKE
Koosharem Reservoir
Burrville
ANTELOPE RANGE
PAVANT
RANGE
Clear Creek
+1.8
+2.0
+4.3
+1.0
+3.4
+4.9
+0.1
+2.0
+1.7
+2.9
-2.5
-3.7
39°15'
39°00'
38°45'
112°15'
112°00'
R. 1 W.
R. 2 W.
R. 3 W.
T. 22 S.
T. 23 S.
T. 24 S.
T. 25 S.
T. 26 S.

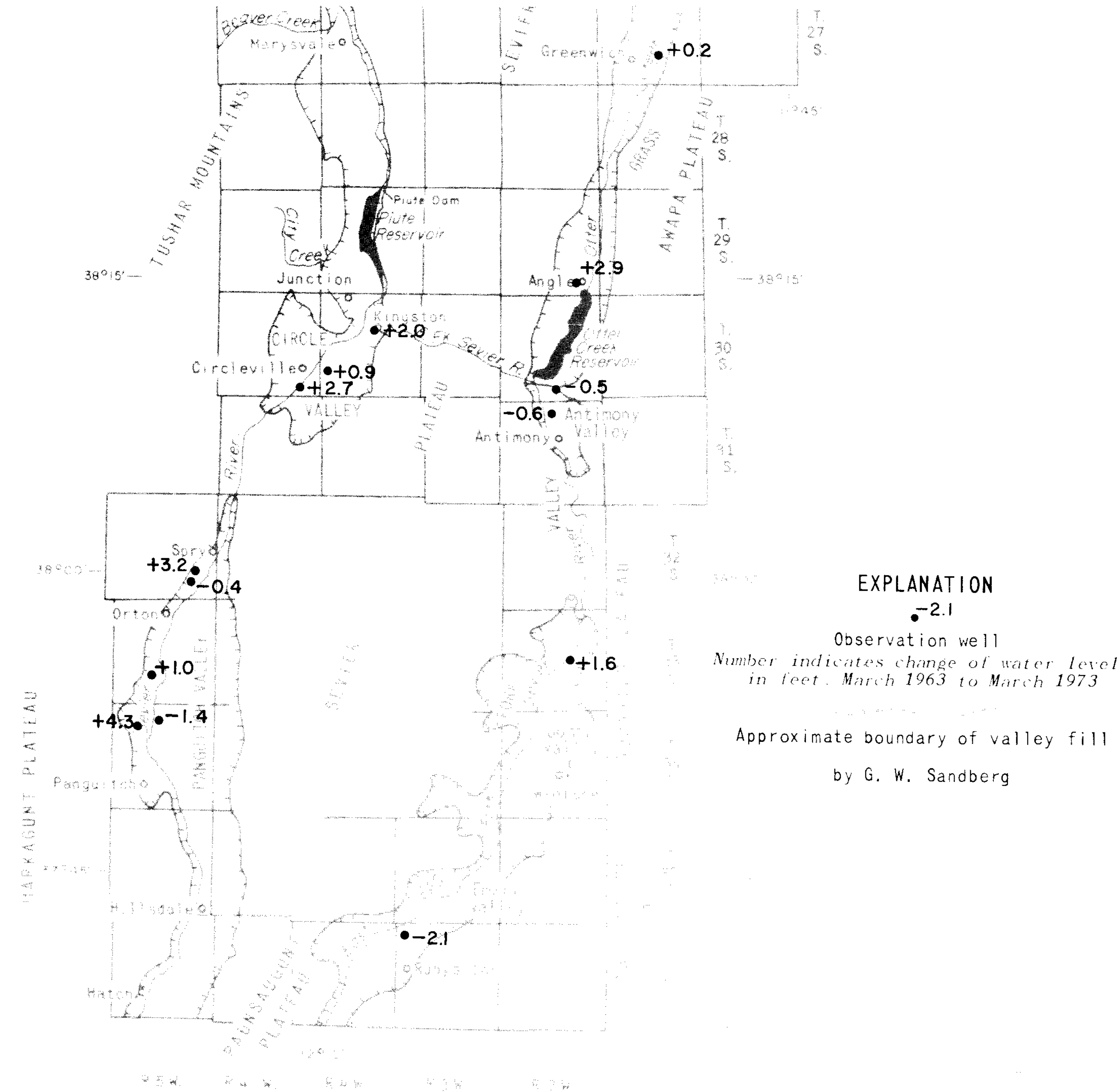


Figure 35.— Map of the upper and central Sevier Valleys showing change of water levels from March 1963 to March 1973.

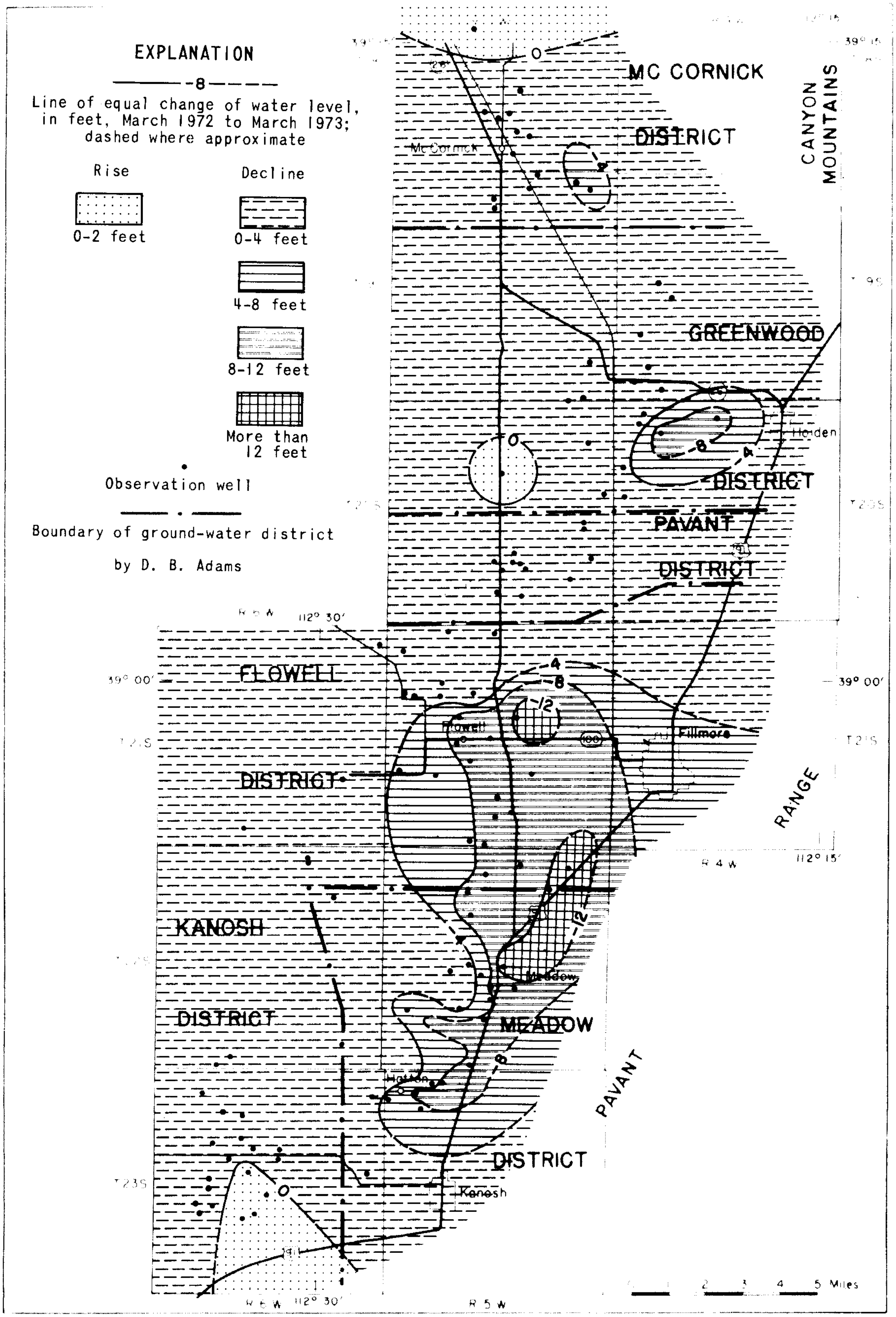


Figure 36.— Map of the Pavant Valley showing change of water levels from March 1972 to March 1973.

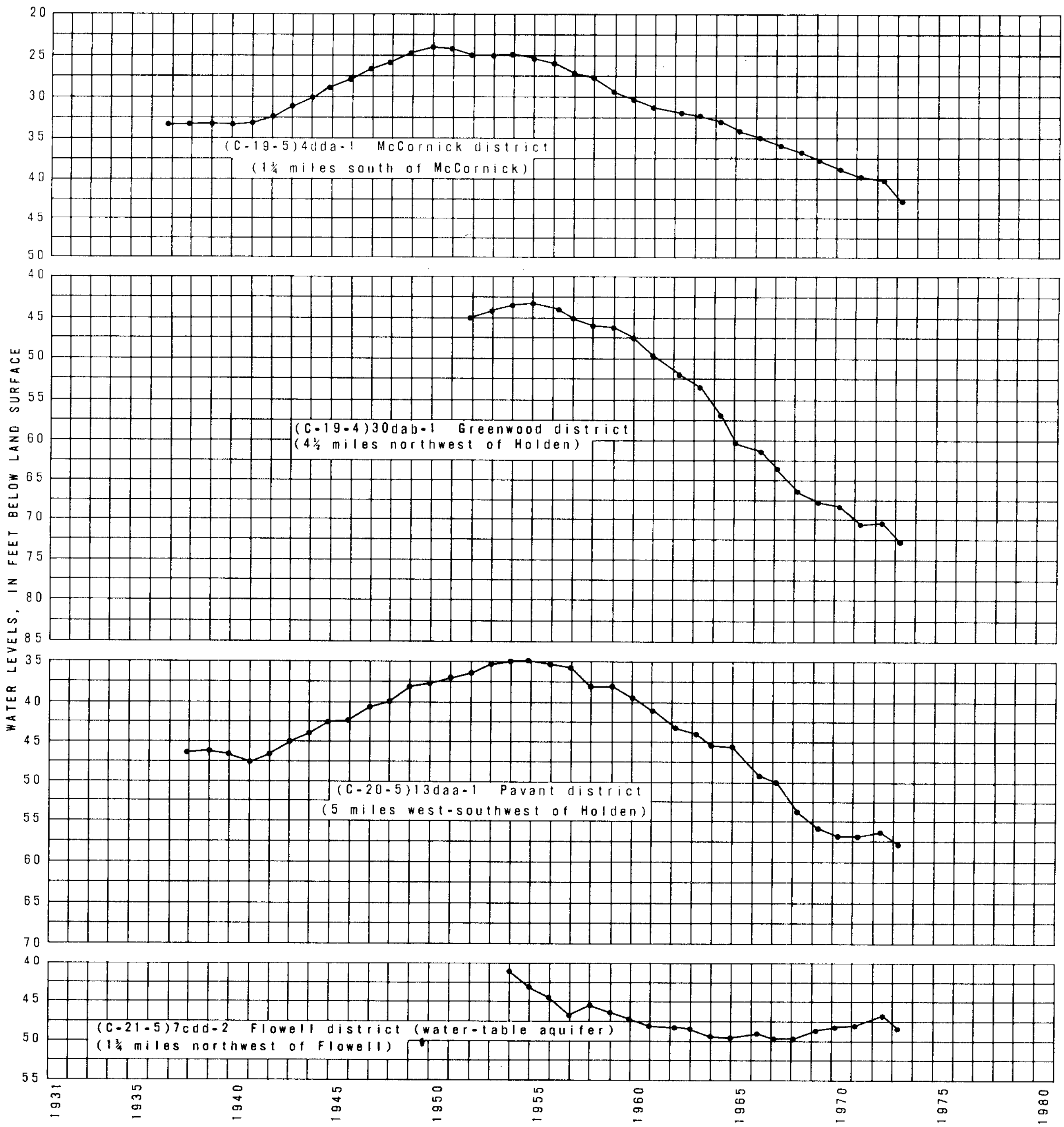


Figure 37.— Relation of water levels in selected wells in Pavant Valley to cumulative departure from the 1931-60 normal annual precipitation at Fillmore.

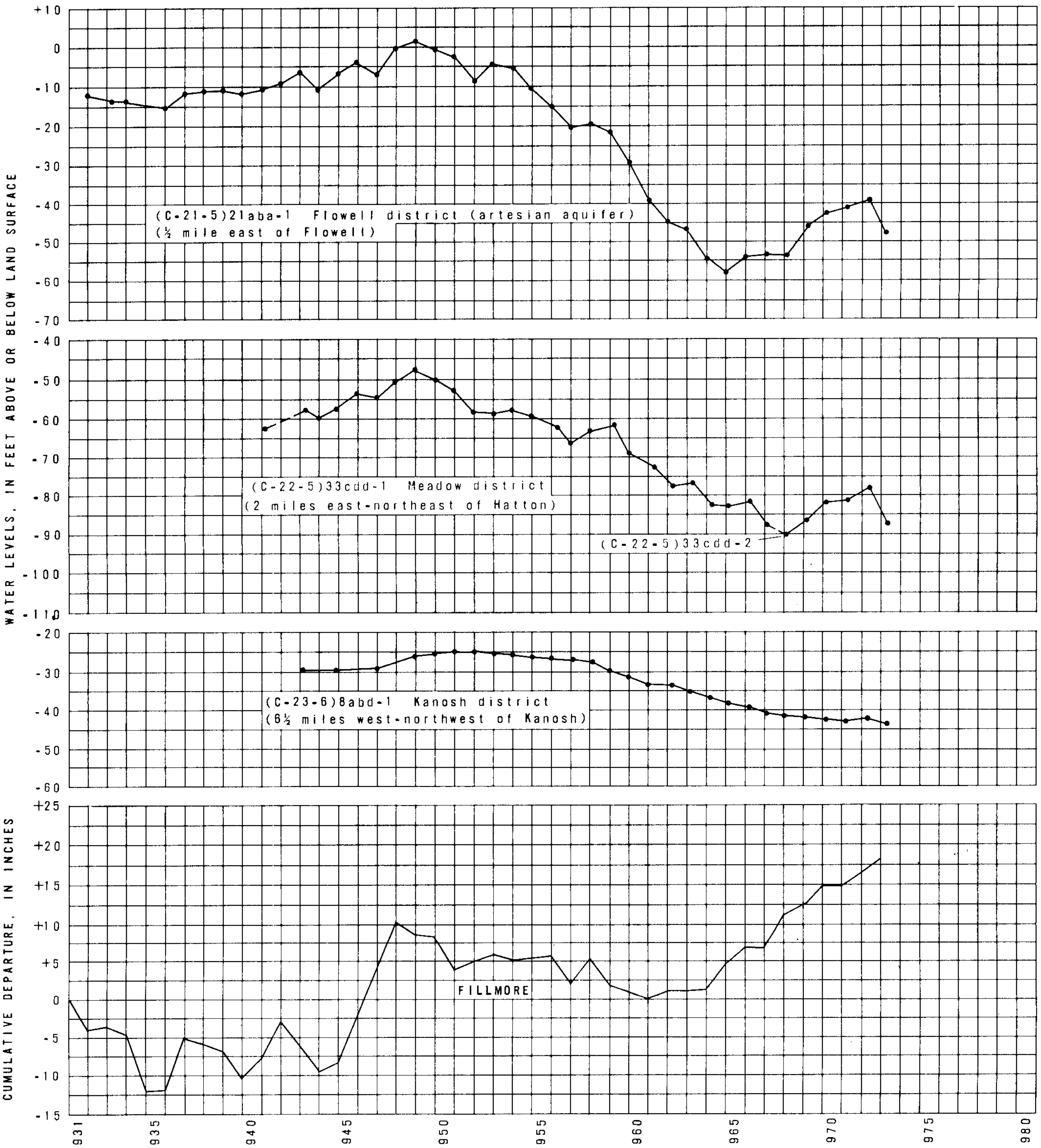


Figure 37.— Continued.

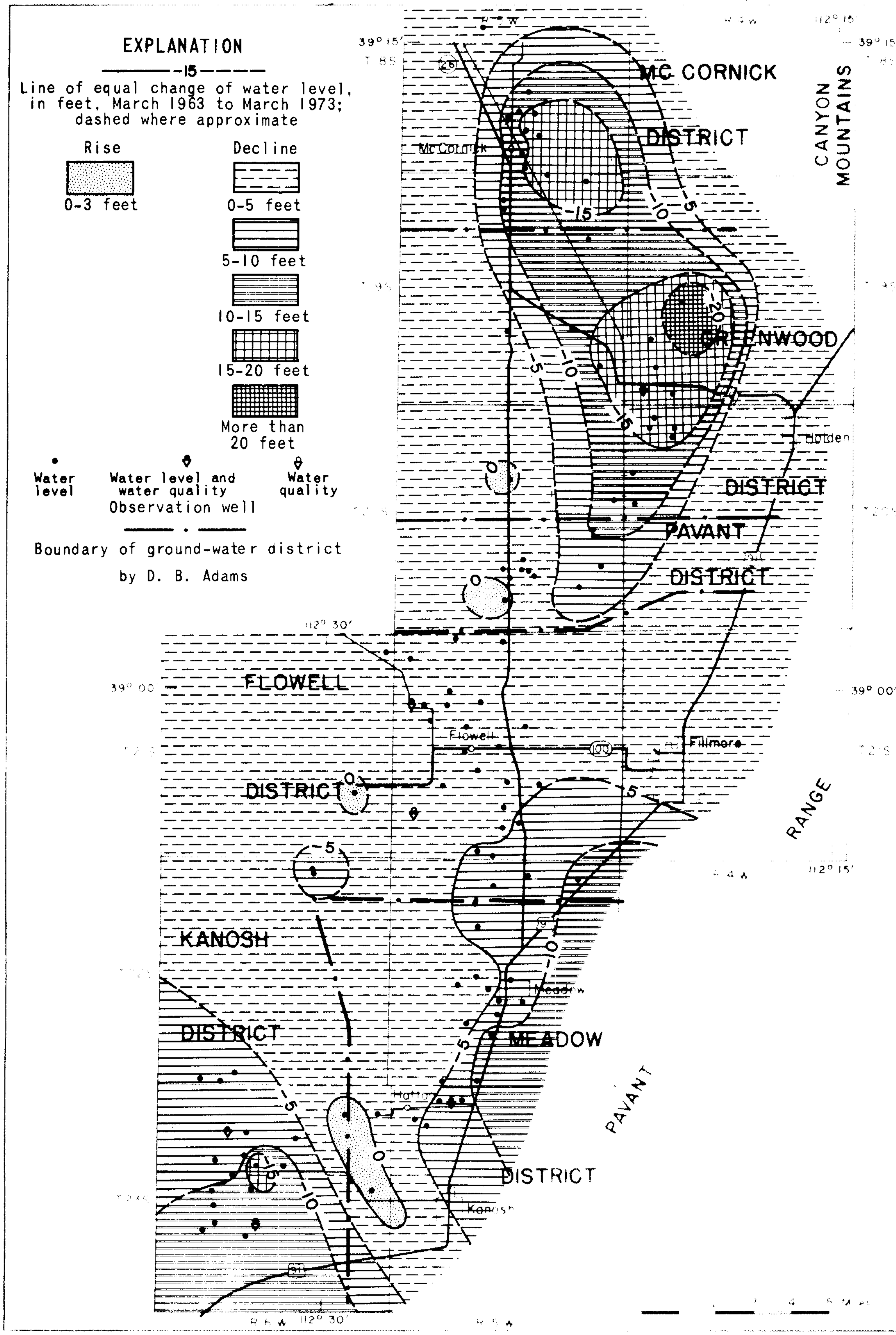


Figure 38.— Map of the Pavant Valley showing change of water levels from March 1963 to March 1973.

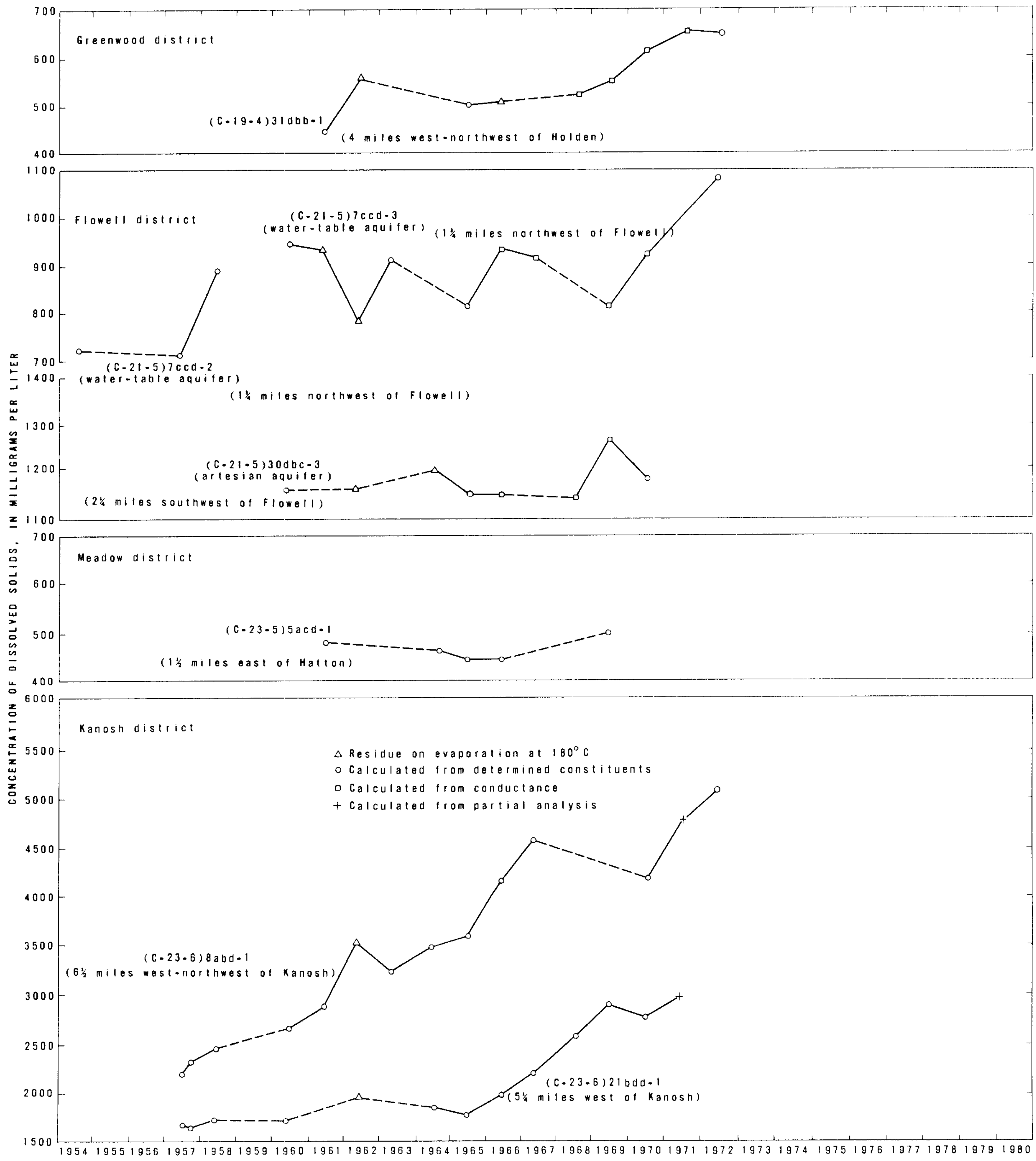


Figure 39.— Concentration of dissolved solids in water from selected wells in Pavant Valley.

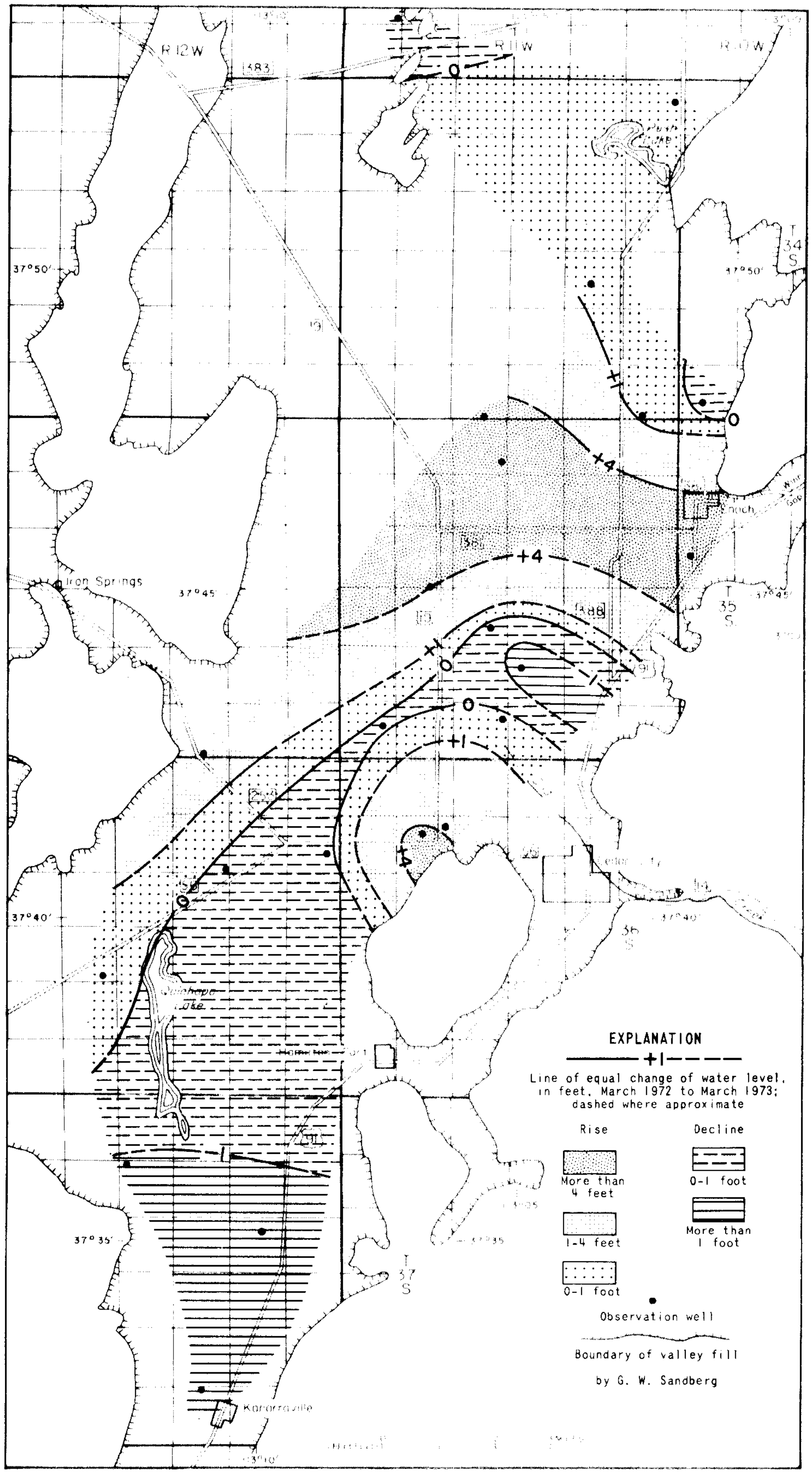


Figure 40.— Map of Cedar City Valley showing change of water levels from March 1972 to March 1973.

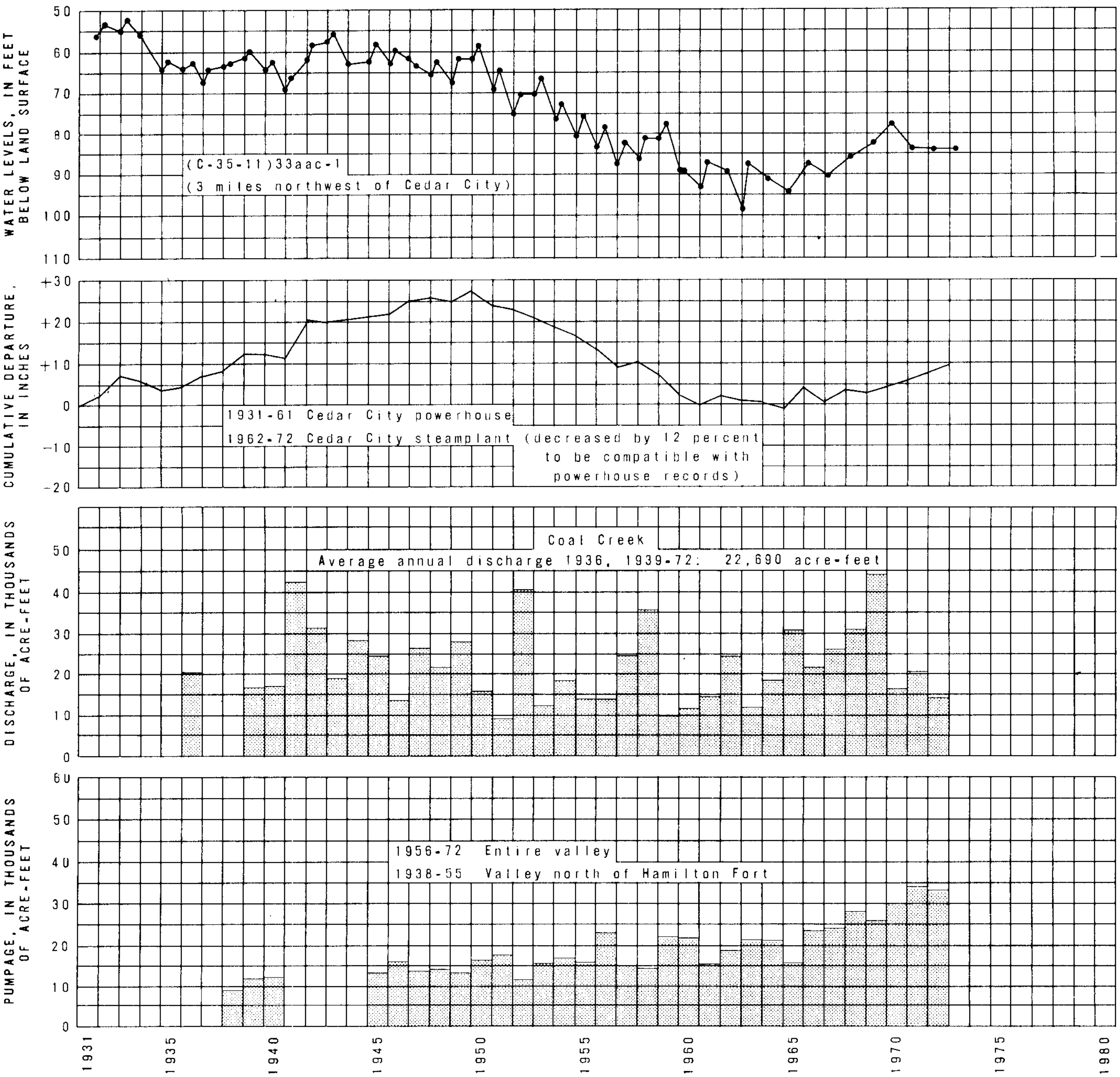


Figure 41.—Relation of water levels in well (C-35-11)33aac-1 to cumulative departure from the 1931-60 normal annual precipitation at the Cedar City powerhouse, to annual discharge of Coal Creek near Cedar City, and to annual pumpage for irrigation in Cedar City Valley.

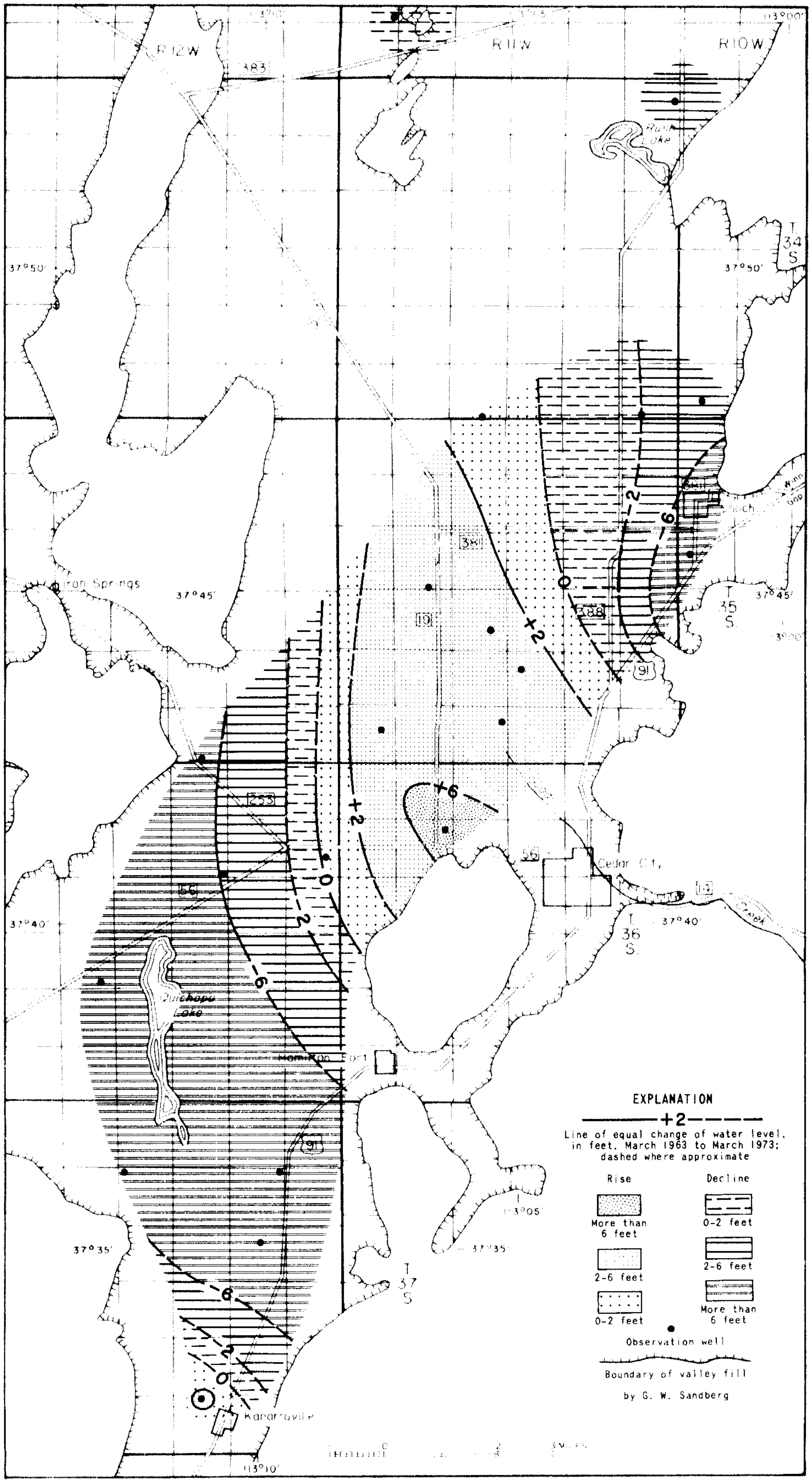


Figure 42.— Map of Cedar City Valley showing change of water levels from March 1963 to March 1973.

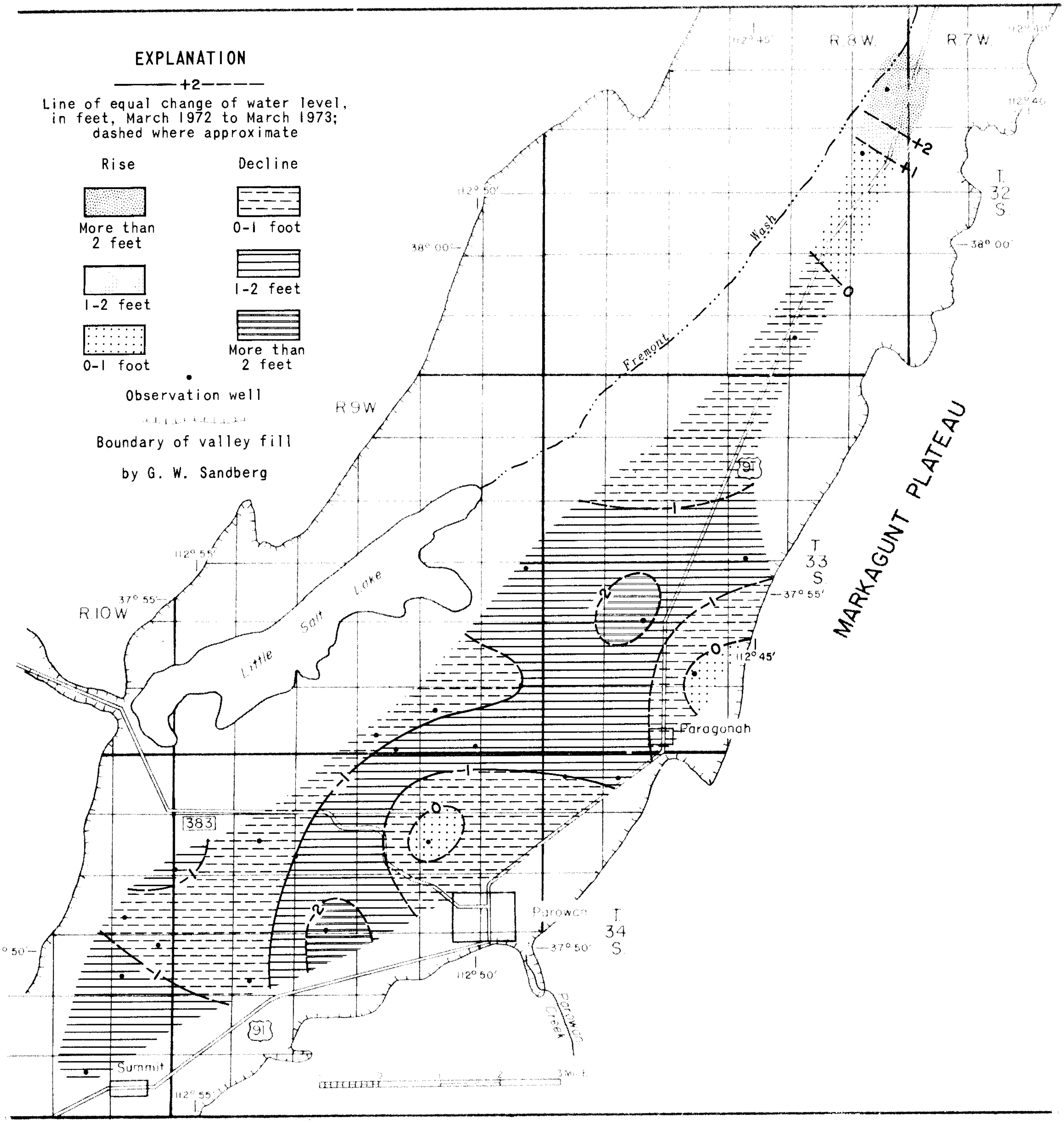


Figure 43.— Map of Parowan Valley showing change of water levels from March 1972 to March 1973.

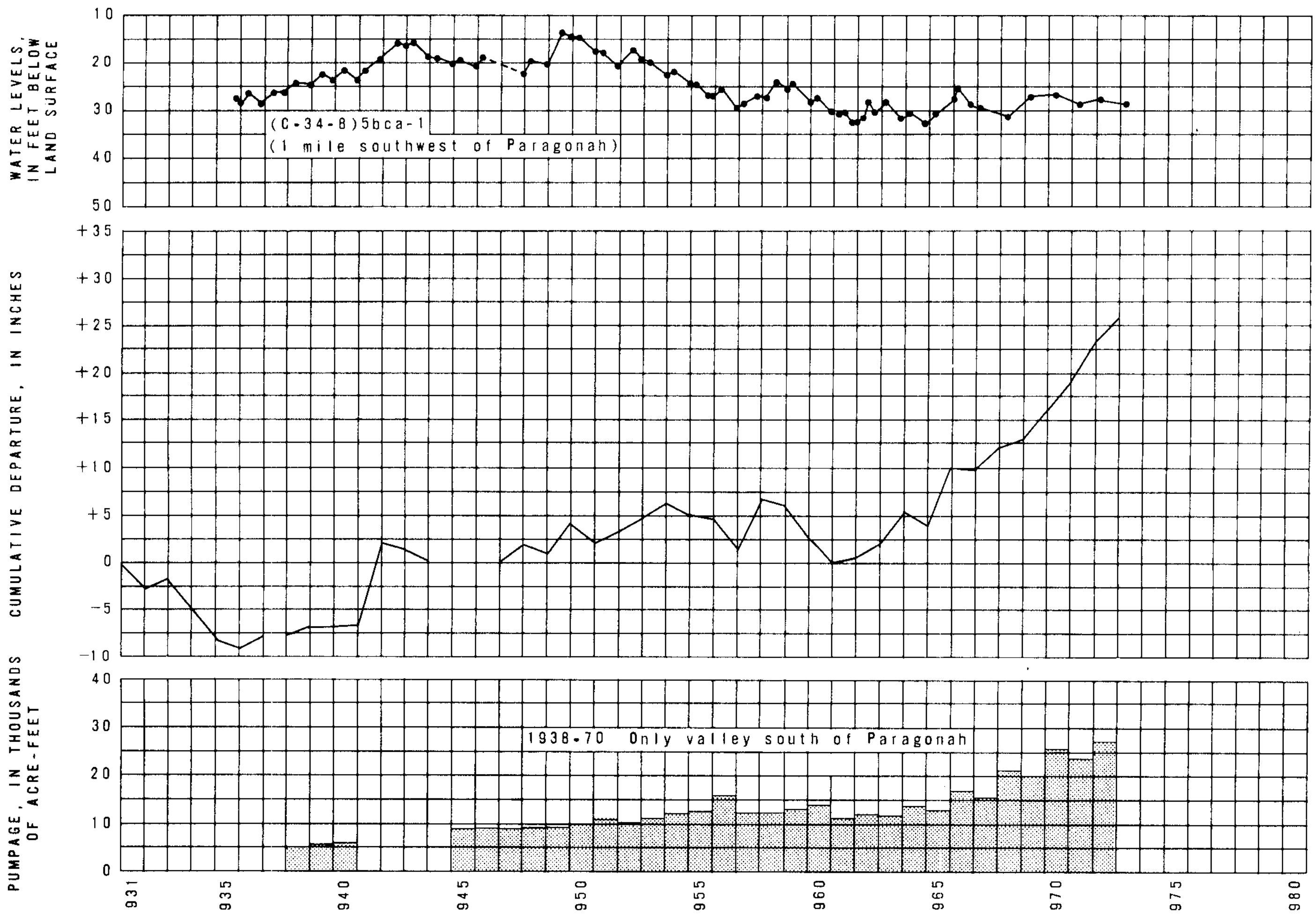


Figure 44.— Relation of water levels in well (C-34-8)5bca-1 to cumulative departure from the 1931-60 normal annual precipitation at Parowan and to pumpage for irrigation in Parowan Valley.

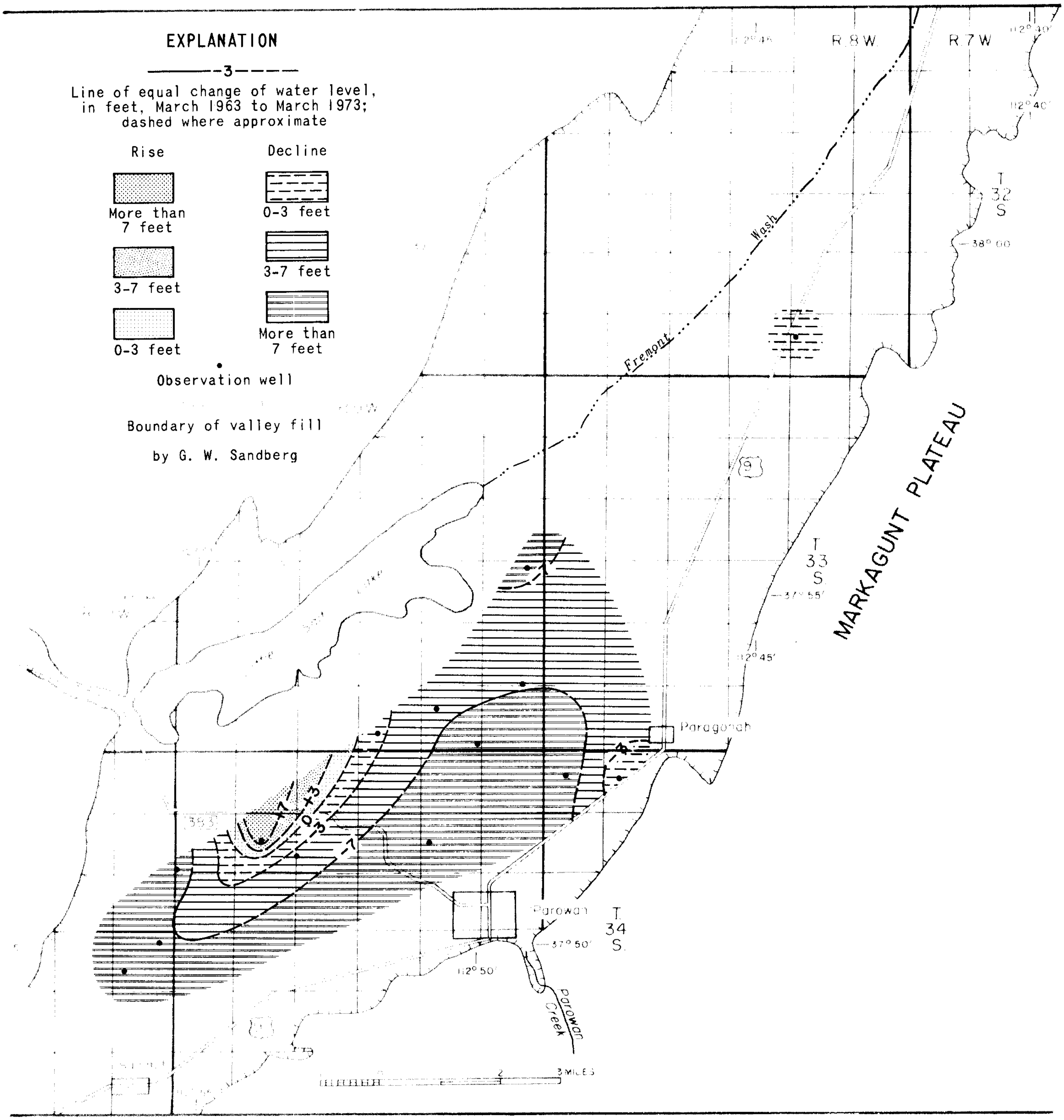


Figure 45.— Map of Parowan Valley showing change of water levels from March 1963 to March 1973.

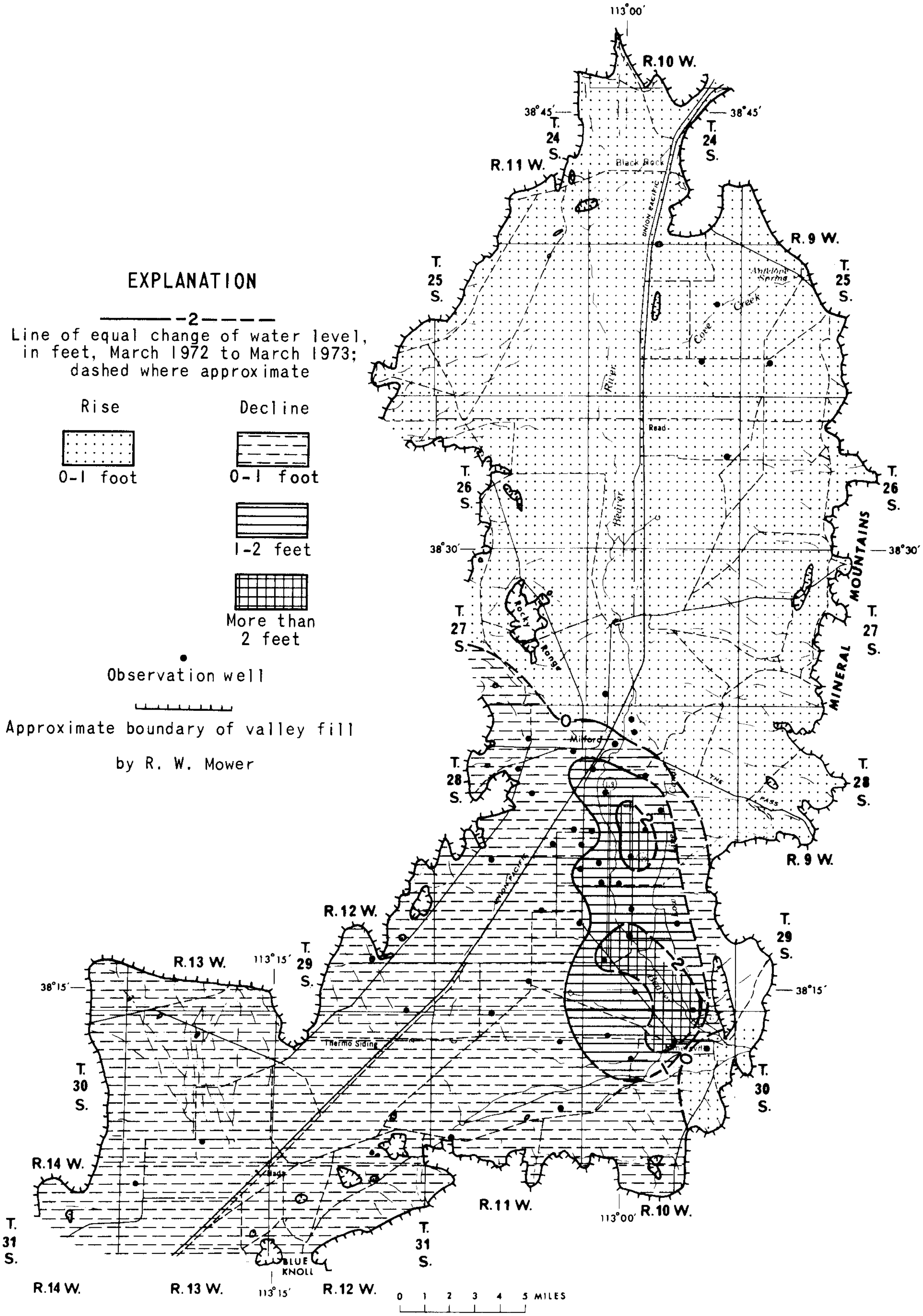


Figure 46.— Map of the Milford area, Escalante Valley, showing change of water levels from March 1972 to March 1973.

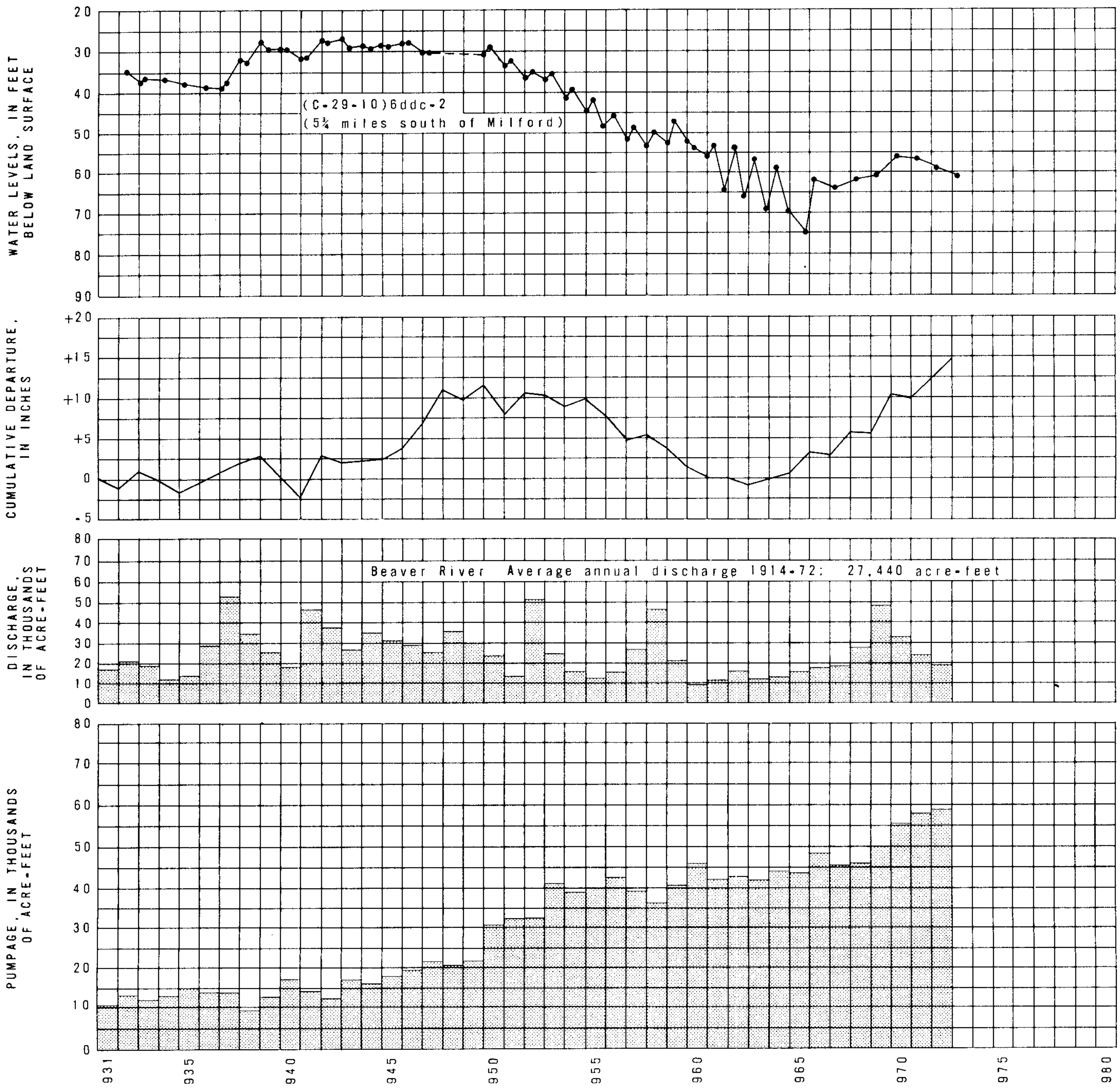


Figure 47.— Relation of water levels in well (C-29-10)6ddc-2 to cumulative departure from the 1931-60 normal annual precipitation at Milford airport, to discharge of Beaver River at Rockyford Dam near Minersville, and to pumpage for irrigation in the Milford area, Escalante Valley.

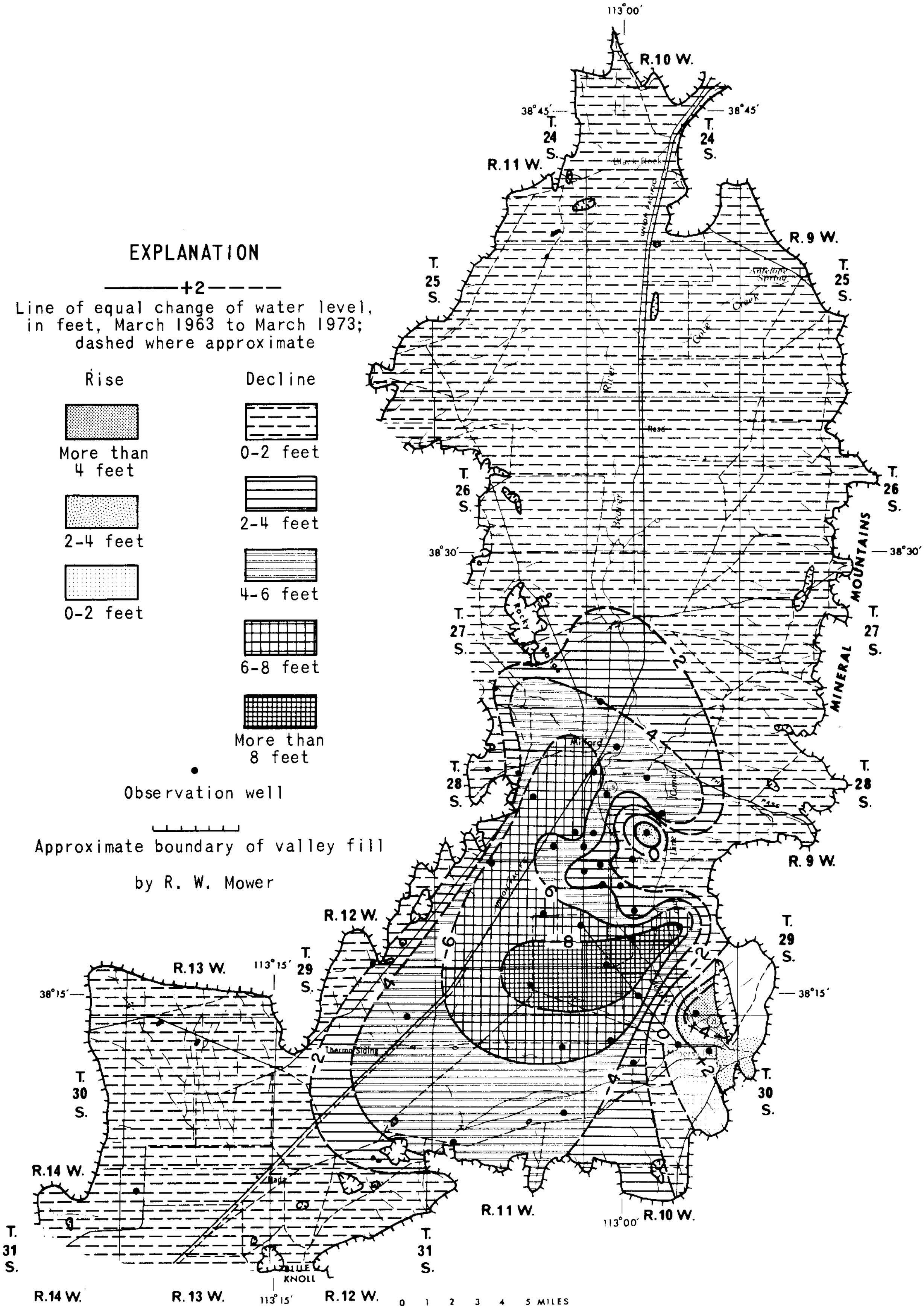


Figure 48.– Map of the Milford area, Escalante Valley, showing change of water levels from March 1963 to March 1973.

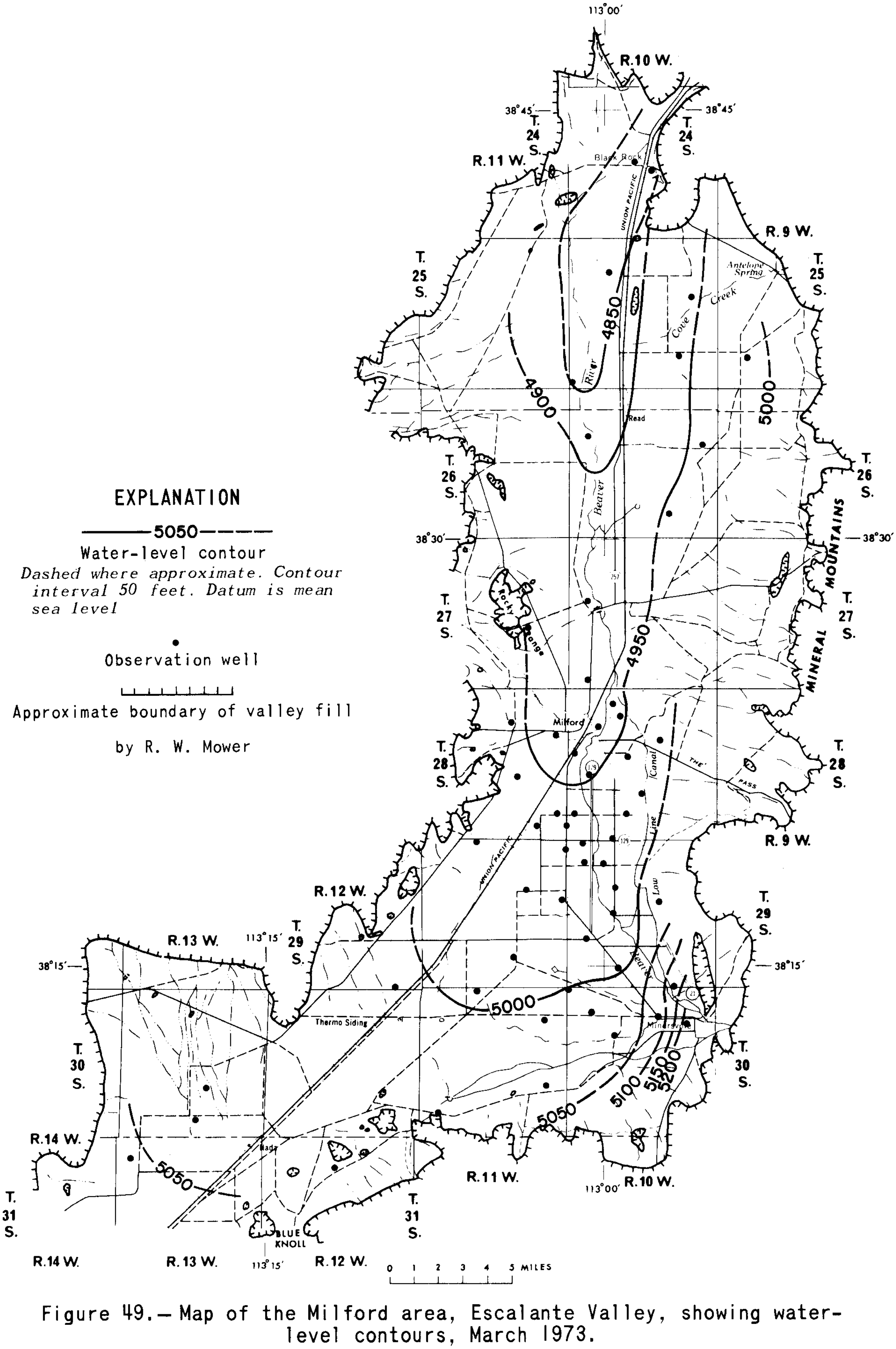


Figure 49.—Map of the Milford area, Escalante Valley, showing water-level contours, March 1973.

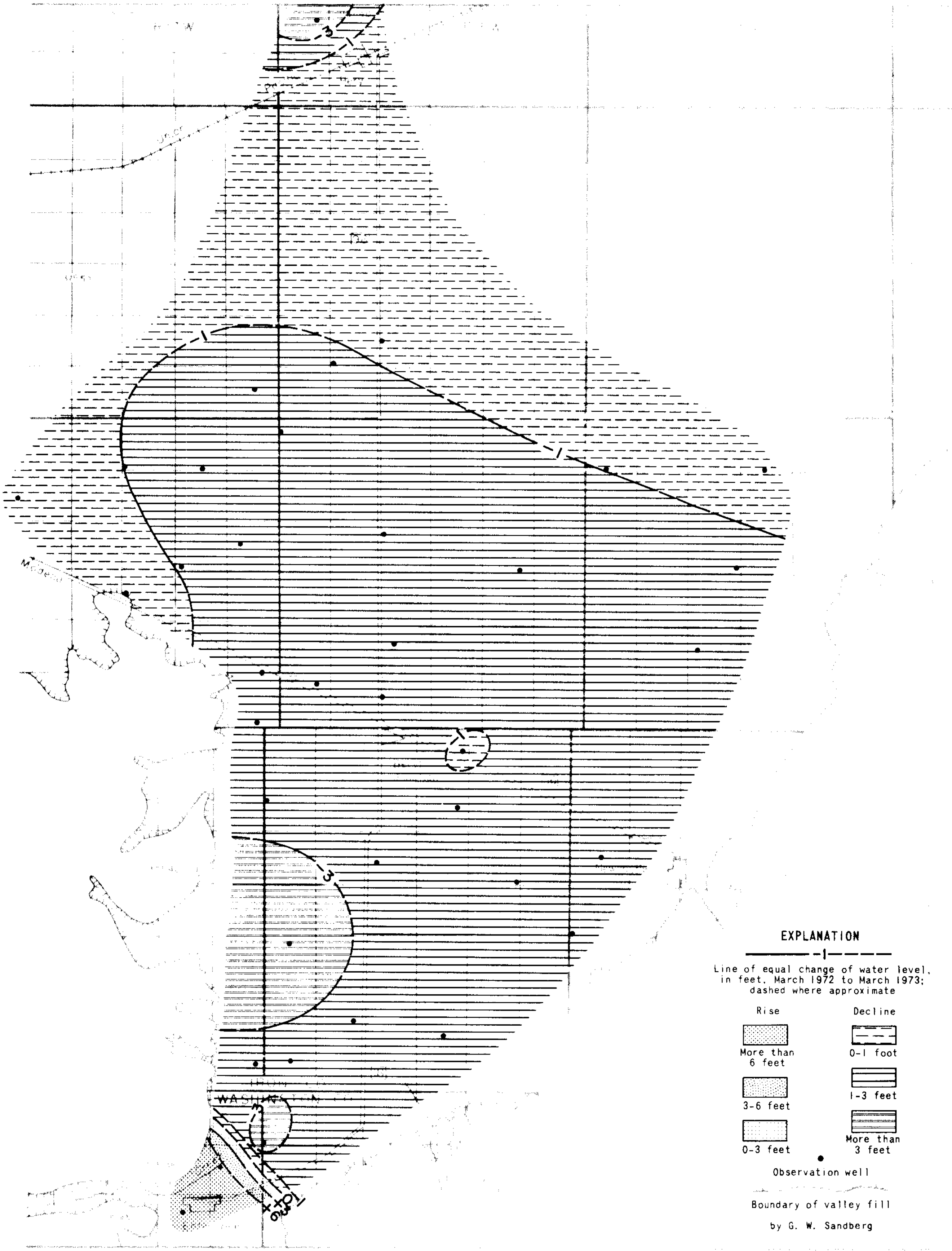


Figure 50.—Map of the Beryl-Enterprise district, Escalante Valley, showing change of water levels from March 1972 to March 1973.

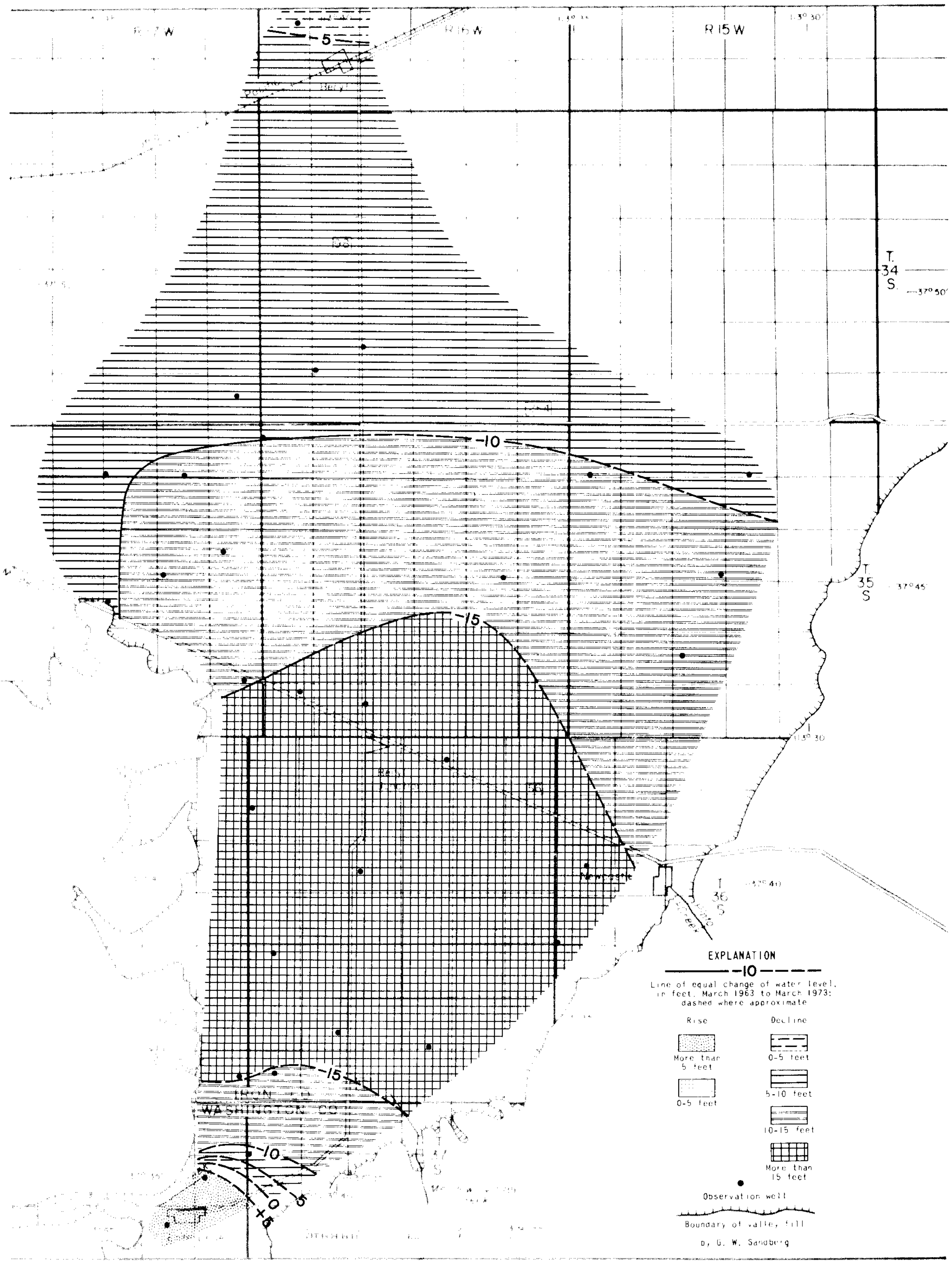


Figure 51.— Map of the Beryl-Enterprise district, Escalante Valley, showing change of water levels from March 1963 to March 1973.

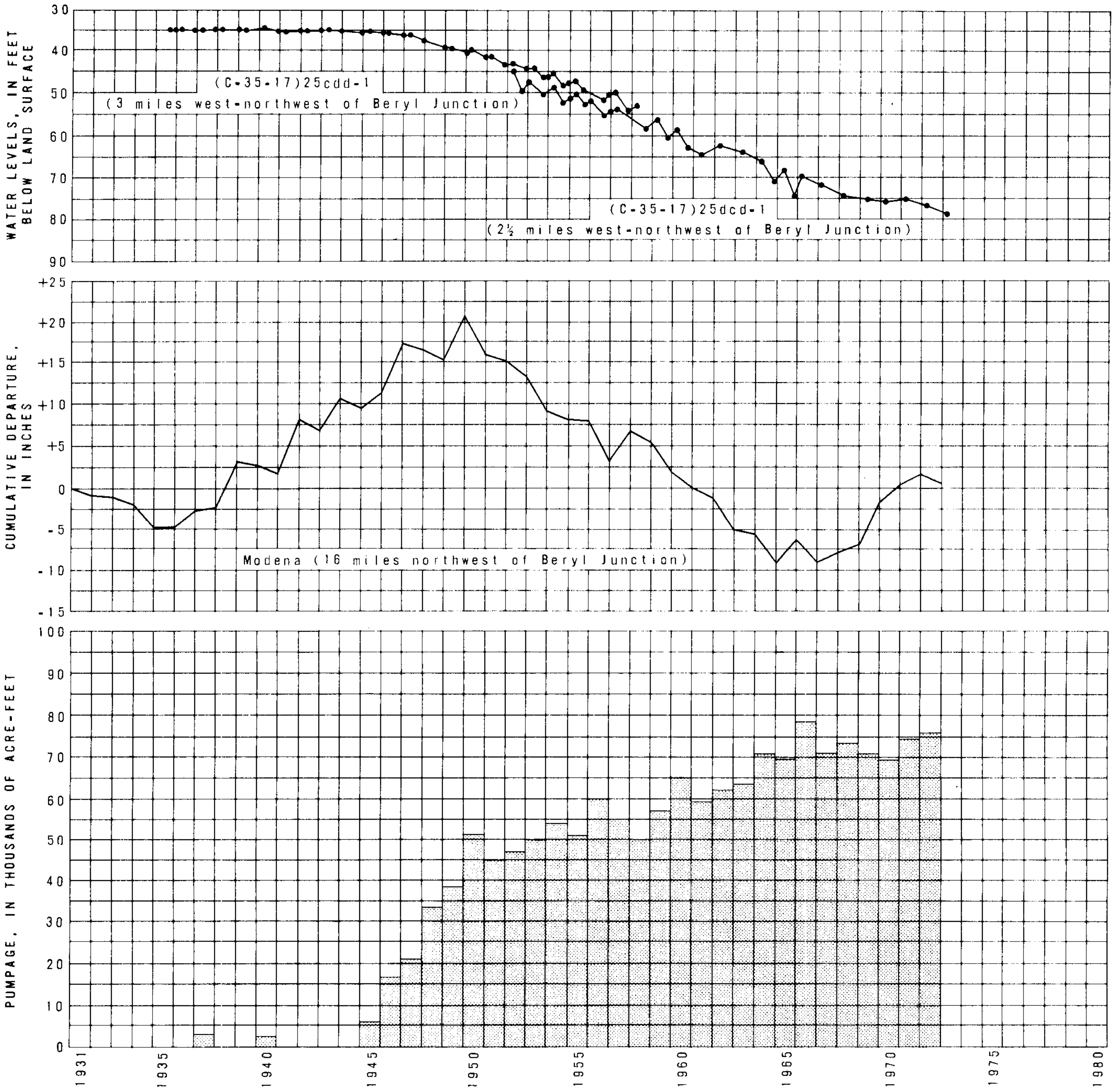


Figure 52.— Relation of water levels in selected wells to cumulative departure from the 1931-60 normal annual precipitation at Modena and to pumpage for irrigation in the Beryl-Enterprise district, Escalante Valley.

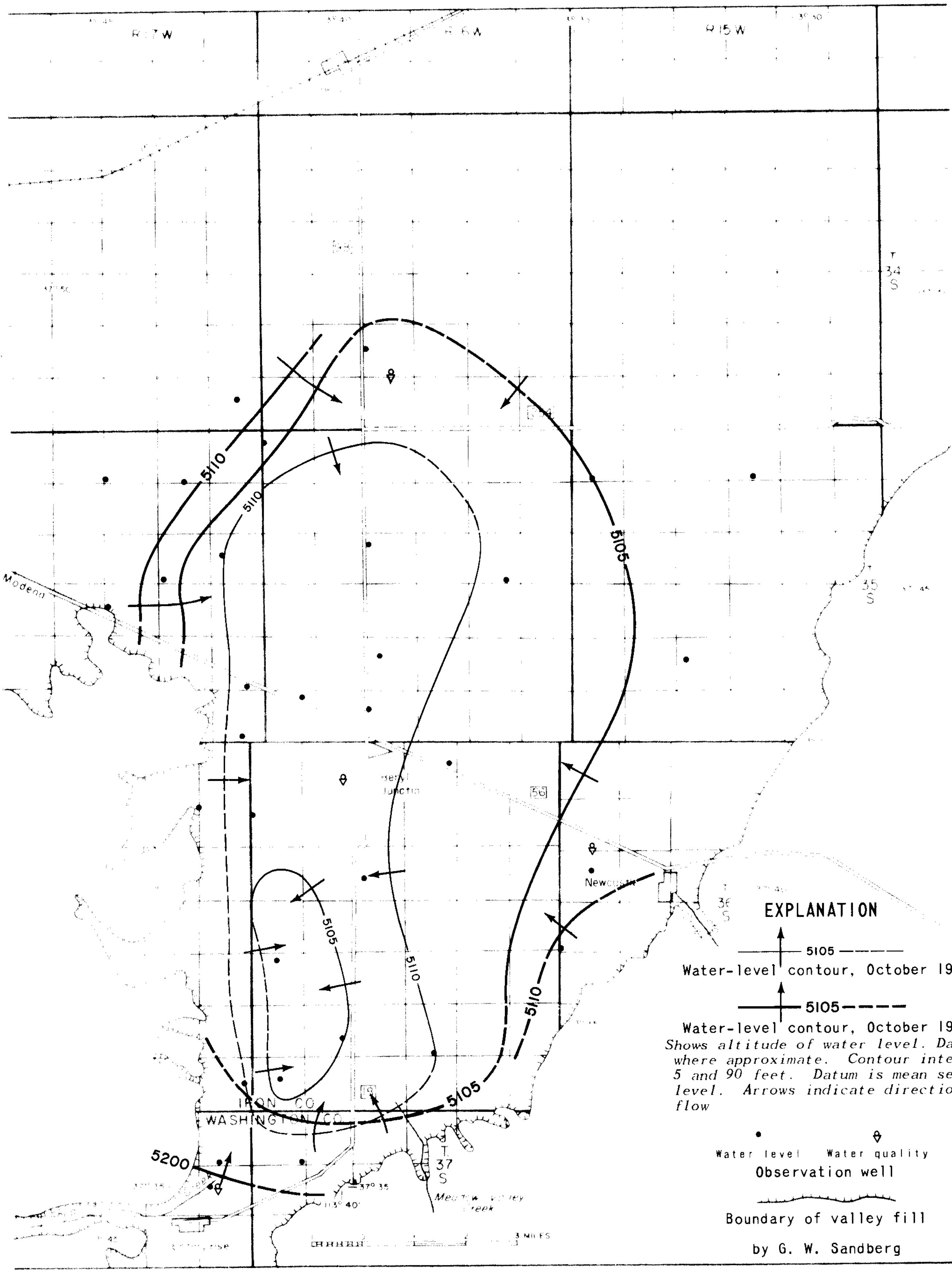


Figure 53.— Map of the Beryl-Enterprise district, Escalante Valley, showing water-level contours, October 1964 and October 1972.

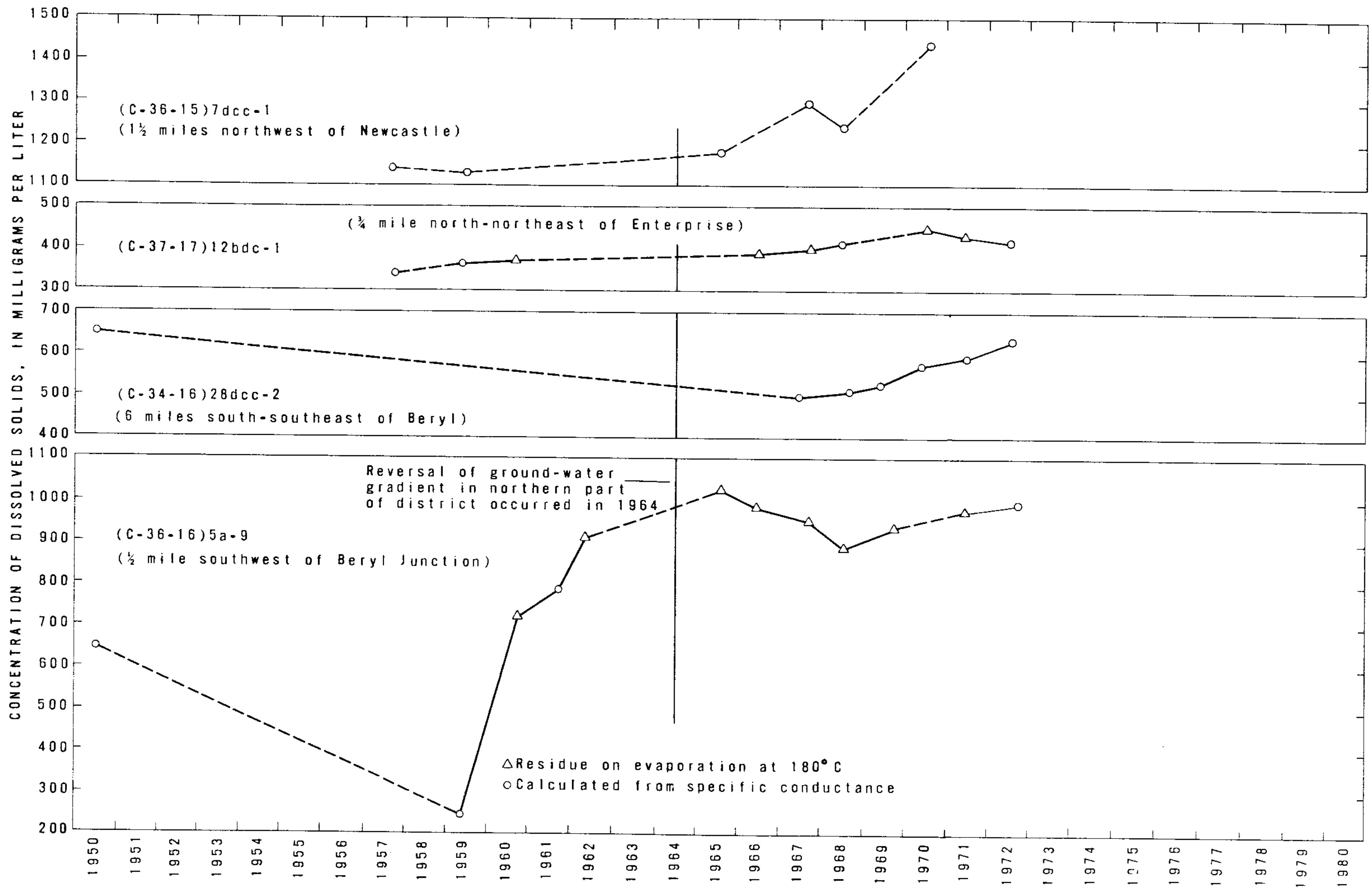


Figure 54.—Concentration of dissolved solids in water from selected wells in the Beryl-Enterprise district, Escalante Valley.

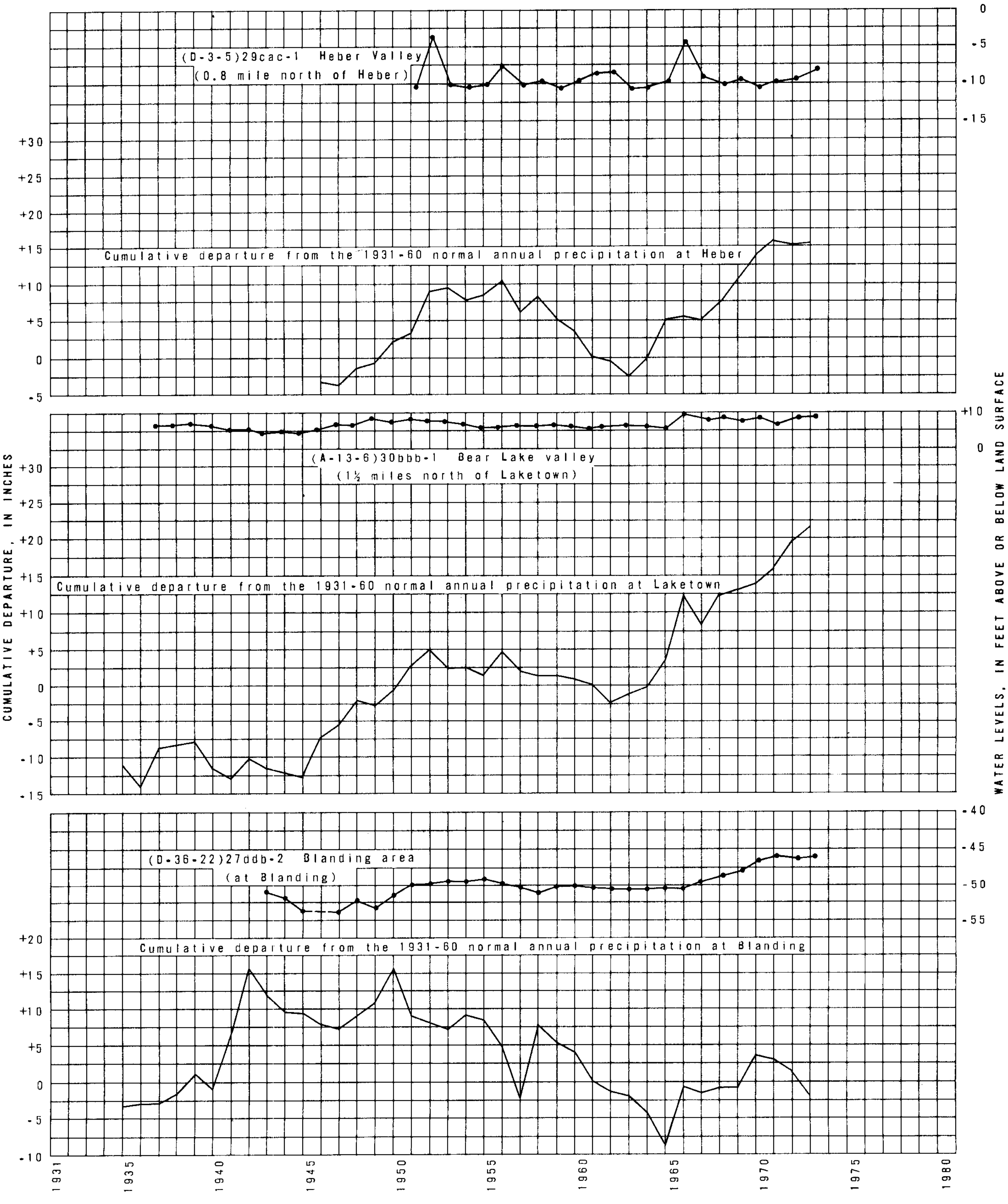


Figure 55.—Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas.

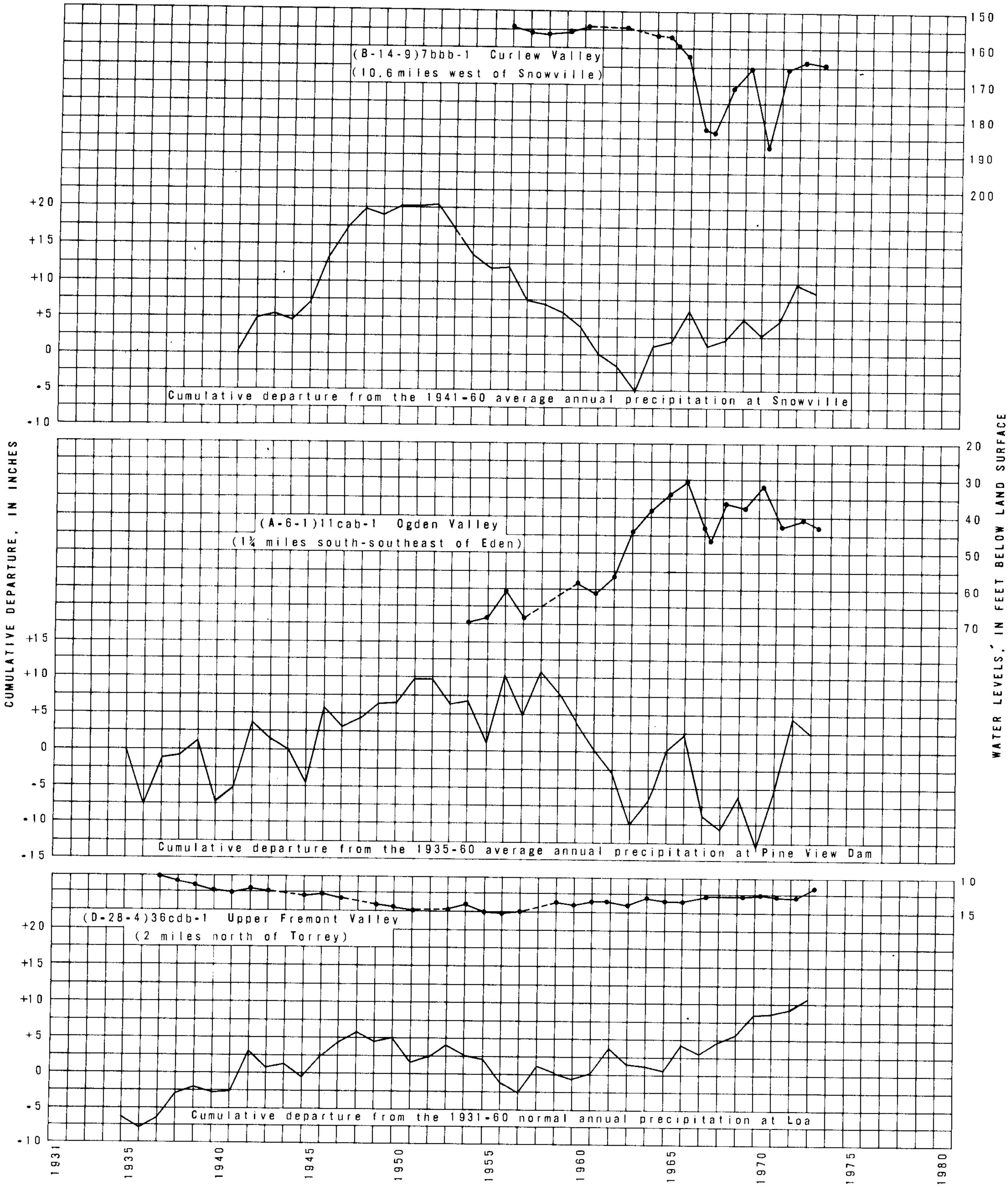


Figure 55.— Continued.

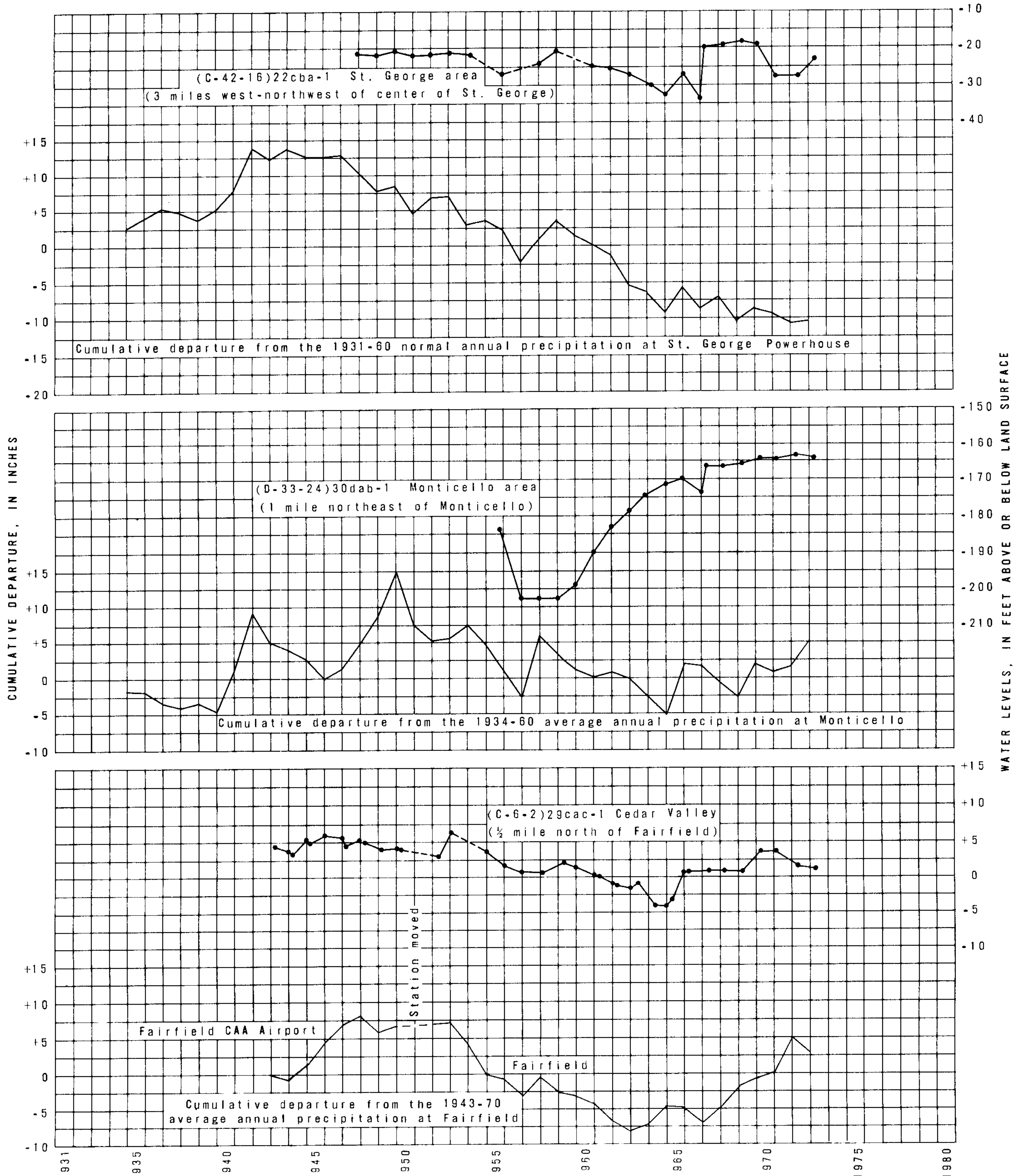


Figure 55.—Continued.

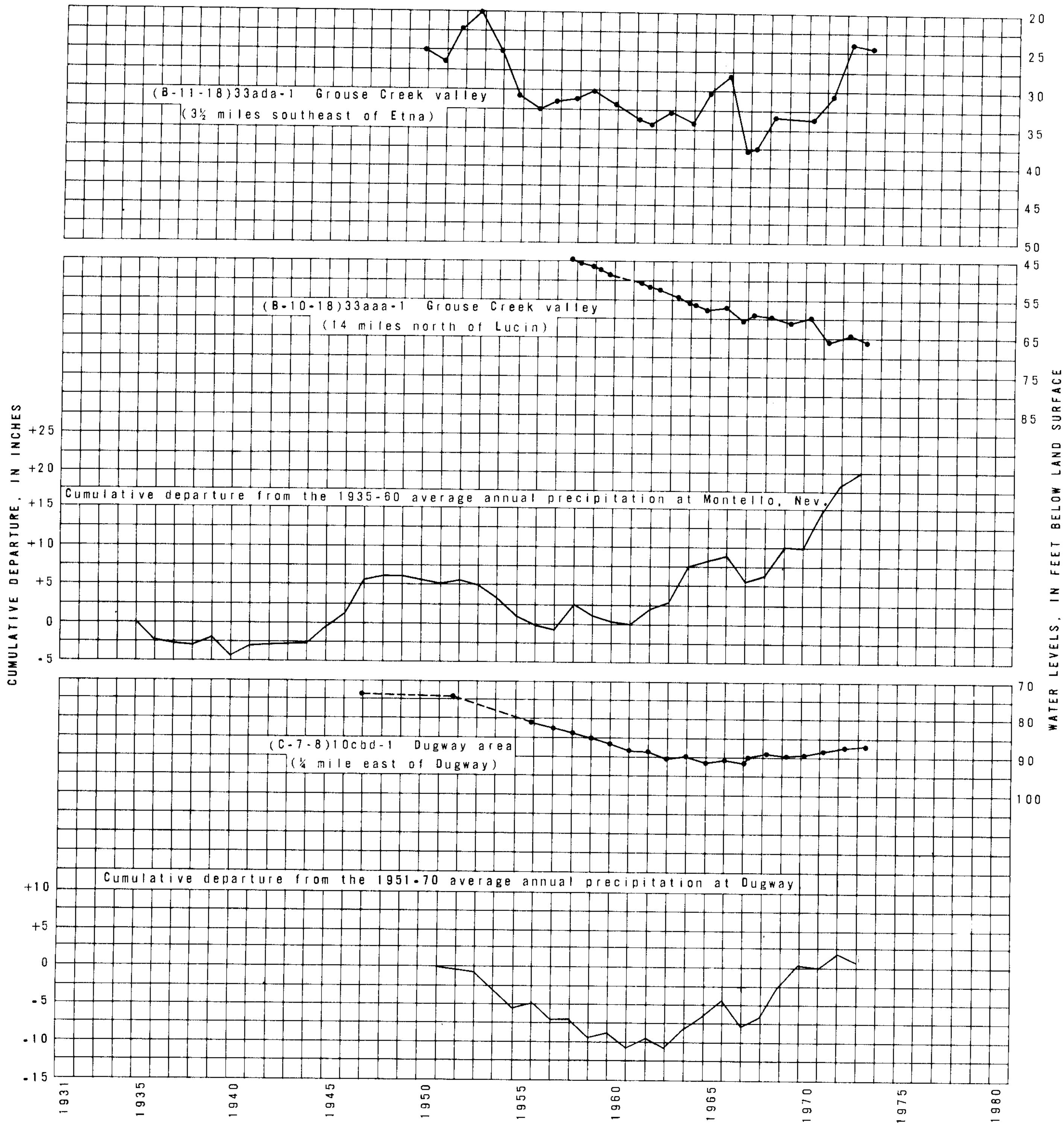


Figure 55.— Continued.

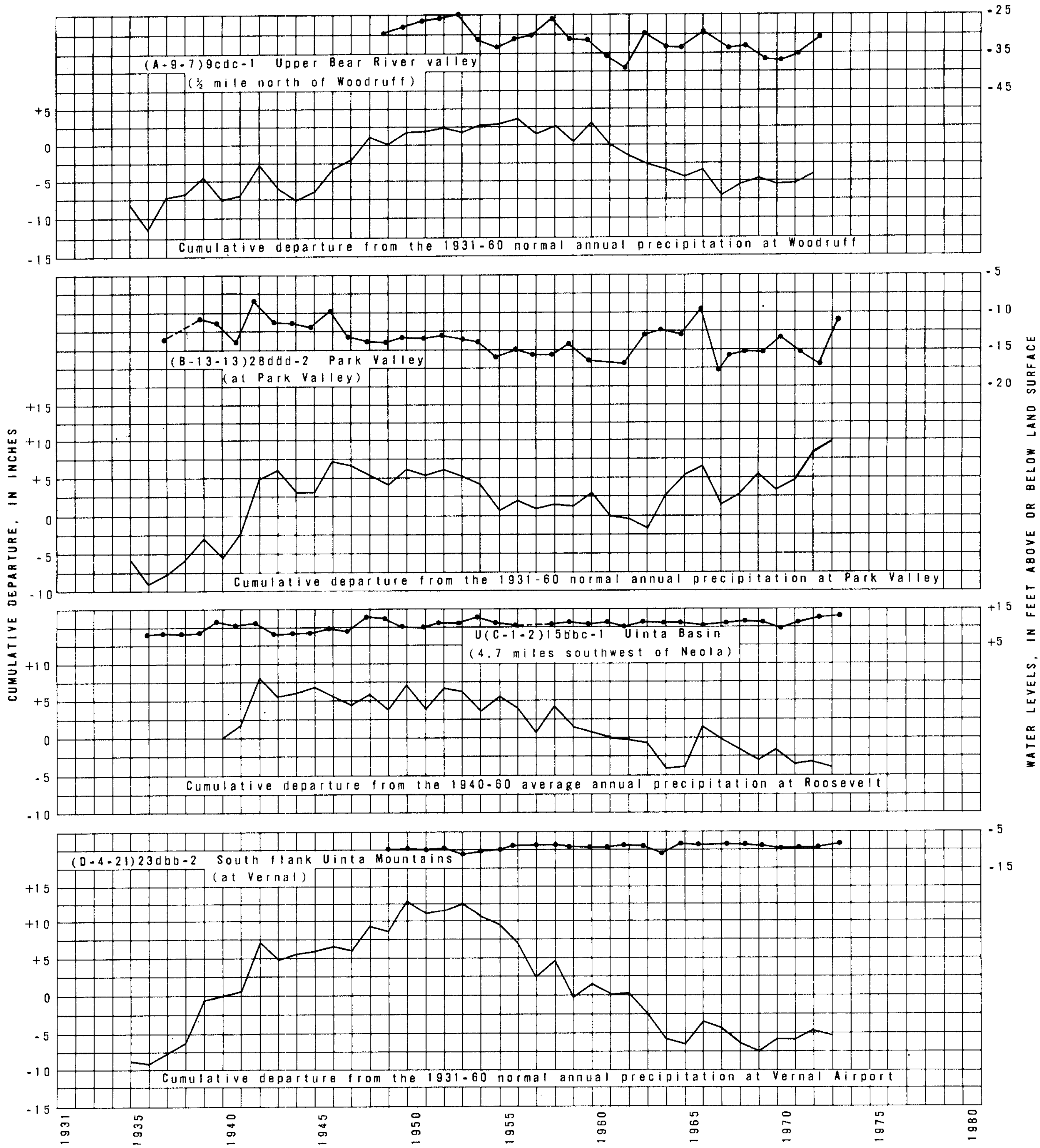


Figure 55.— Continued.

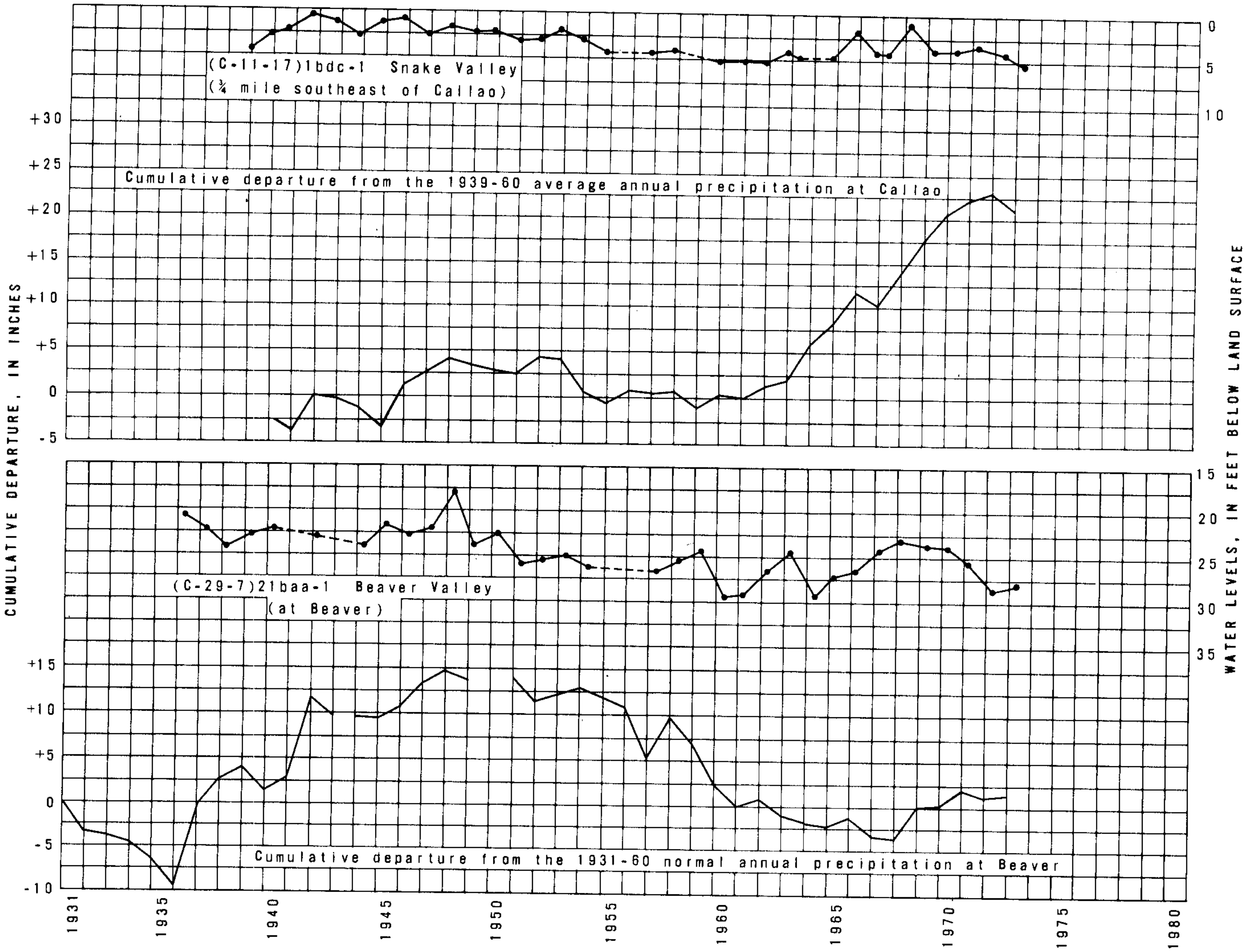


Figure 55.— Continued.

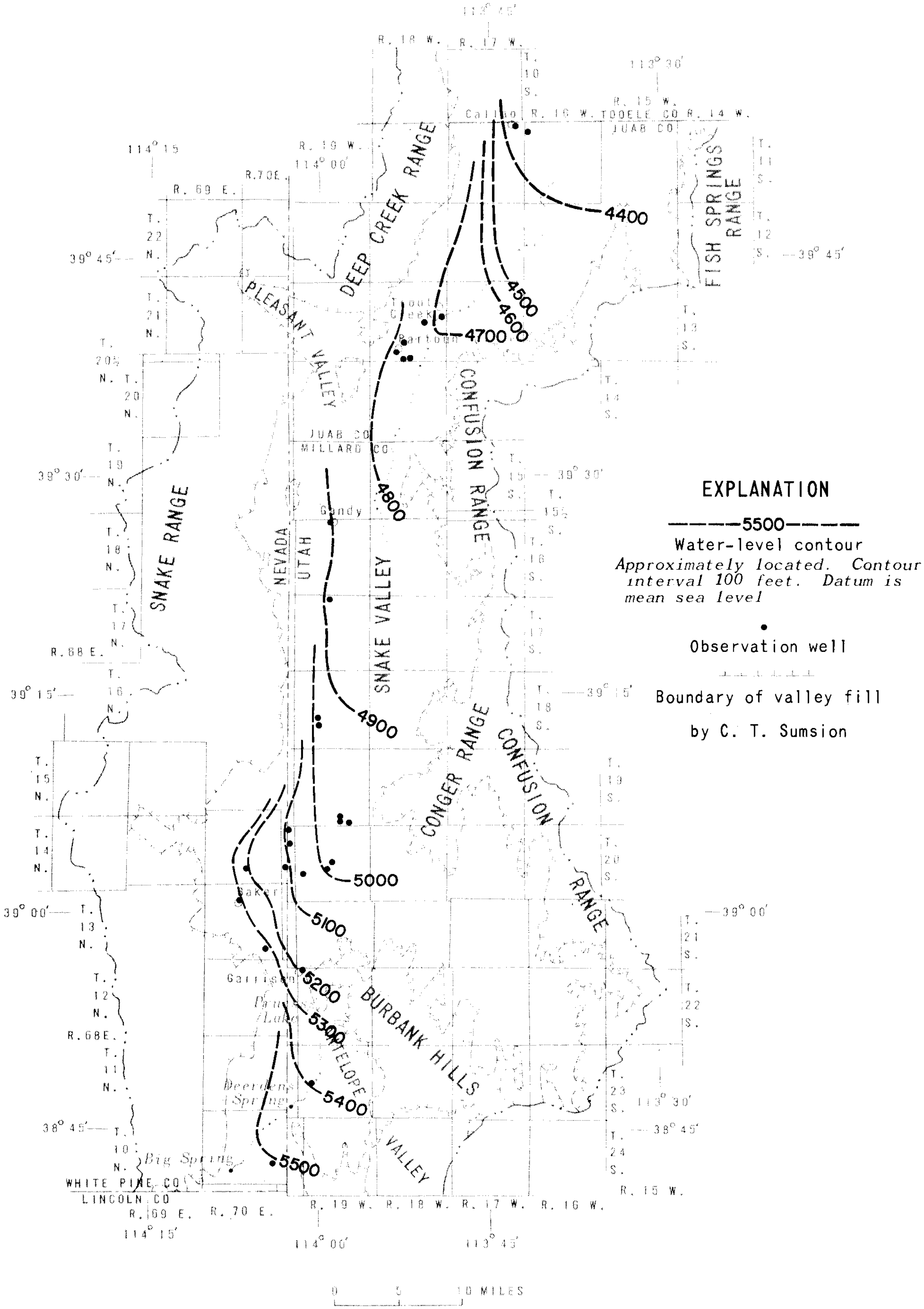


Figure 56.—Map of Snake Valley showing water-level contours, March 1973.